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METEOROLOGICAL ROCKET NETWORK SYSTEM RELIABILITY.(U)
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METEOROLOGICAL ROCKET NETWORK SYSTEM RELIABILITY

MARCH 1979

By

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes procedures used to determine meteorological rocket system reliability throughout the Meteorological Rocket Network. It discusses the reasons for implementing the program, provides examples of output, identifies problem areas, and includes samples of monthly and cumulative results. Also included are procedures for reporting failures, a glossary of failure modes, instructions for implementing the program on a UNIVAC 1108 computer, and a tabulated list of the computer program.

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CONTENTS

BACKGROUND

Since 1959 the Meteorological Rocket Network (MRN) [1] has routinely launched small rockets at least three times per week from up to fourteen stations. During this period several types of rockets and payloads have been used to measure atmospheric parameters. Initially, the Loki anti-aircraft rocket was modified to carry radar reflective chaff to make wind measurements up to 50 km altitude. In the early 1960s the Arcas rocket system was developed and deployed as the standard measurement device throughout MRN. The Arcas carried an active temperature sensor and telemetry package that transmitted atmospheric thermodynamic data to ground receiving stations. The sonde, an Arcasonde 1A, was deployed on a metallized 4.5-m silk hemisphere decelerator which was tracked by radar. Wind speed and direction and altitude were thus derived.

Concurrently with the development and deployment of the Arcas, several government agencies initiated meteorological rocket (metrocket) and payload development programs designed to reduce the unit cost per firing. These various efforts resulted in the development of the Loki Datasonde, which is now used as the standard measurement system throughout the MRN. The Loki Datasonde also measures temperature and wind in a manner similar to the Arcas. The Loki did significantly reduce the cost per round.

During the mid-1970s, a large quantity of statistical data was collected on MRN failure rates. This information revealed a number of systematic failures. It was obvious, however, that definition of failure modes throughout the network was not uniform, which led to some uncertainty as to the meaning of the statistical data.

At the 1977 winter meeting of the Subcommittee on Meteorological Rocket Observations (SMRO) of the Interdepartmental Committee on Applied Meteorological Research (ICAMR), the US Army Atmospheric Sciences Laboratory (ASL) was tasked to establish a uniform meteorological rocket system reliability program. The SMRO named a working group consisting of the following persons:

<u>Chairman</u>

Bruce W. Kennedy	Atmospheric Sciences Laboratory

<u>Members</u>

B. R. Hixon	Pacific Missile Test Center
Francis Schmidlin	Wallops Flight Center
O. H. Daniel	Eastern Test Range
Ernest Fisher	Air Weather Service

The committee met, drafted a uniform failure mode glossary, and presented it at the 1977 summer SMRO meeting. After minor revisions, the glossary was approved.

This report describes meteorological rocket system reliability procedures and glossary, illustrates its utility, and provides the computer program and operating instructions.

DESCRIPTION OF SYSTEMS

Figure 1 illustrates the family of Loki rockets currently used by the MRN. The Federal Meteorological Handbook No. 10 [2] describes these systems as follows.

"PWN-8B. A motor dart configuration. The motor (Loki) is an internal burner with a 1.9 second burn time after which it drag separates from the dart. The dart then coasts to apogee. The motor is 7.6 cm in diameter. The dart is 3.7 cm in diameter and 101.6 cm in length. It contains a 1680 MHz rocketsonde with 10-mil bead thermistor and 2.3 meter diameter starute decelerator. The dart reaches an altitude of over 60 km from sea level.

"PWN-10A. A motor dart configuration. The motor (Super Loki) is an internal burner with a two-second burn time after which it drag separates from the dart. The motor is 10.2 cm in diameter. The dart is 5.4 cm in diameter and 131.3 cm in length. It contains transpondersonde incorporating a 1680 MHz carrier and 403 MHz ranging system along with 10-mil bead thermistor and 3.1 m diameter starute decelerator. The dart reaches an altitude of over 75 km from sea level.

"PWN-11A. Same as the PWN-10A except that the dart and payload are identical to that of the PWN-8B, and the motor has an interstage on the head cap to provide a stable motor trajectory. The PWN-11A dart reaches an apogee of over 70 km from sea level.

"PWN-12A. The motor is the same as the PWN-10A. The dart is 4.1 cm in diameter and contains a payload consisting of a 1 meter diameter inflatable sphere of metallized mylar. The dart reaches an apogee of over 115 km from sea level."

The PWN-12A metrocket system, commonly referred to as the ROBIN sphere, measures the meteorological parameters of wind, temperature, density, and pressure. Unlike the Loki, the ROBIN is completely passive, and data are derived by using position information from a precision radar track of the sphere [3].

Table 1 shows the utilization of these systems at the various MRN stations during the period October 1977 to March 1978.

SYSTEM RELIABILITY

The establishment of a system reliability program required several things: cooperation of all participating agencies, a uniform glossary of metrocket failure modes, a computer program, a central processing facility, and timely submission of information. Cooperation was insured through the participation of SMRO members. A list of failure modes was prepared to the satisfaction of SMRO members. A system reliability format was designed and the computer program prepared. Each participating agency and station was provided with forms, instructions, and a glossary (Appendix A). MRN reporting began on 1 October 1977.

Tables 2 and 3 show typical monthly outputs of the system reliability program. In table 2, the left-hand column indicates the failure mode of the rocket system. The next column indicates the quantity of failures throughout the network. Twc major problems appear in this list: nine failures were due to low rocket apogee (code 24), and sixteen failures were attributable to sonde cutoff (total loss of the transmitted signal, code 32) at expulsion. The remaining columns give serial numbers and lot numbers of the various rocket components so that correlative studies can be run. Both of these failure types were thoroughly investigated by agency representatives and the rocket manufacturer, causes of the failure were determined, and corrective action was taken.

The sonde cut off at expulsion because the instrument packaged inside the dart was free to move a fraction of an inch along the longitudinal axis. Positive and negative accelerations during rocket boost phase and payload expulsion induced excessive shock forces through the sonde, and this action resulted in failure of the transmitter tube. To correct the problem a small O-ring shock absorber and spacer were placed over one end of the sonde. This covering filled the void and virtually eliminated shock induced failure of the transmitter.

The investigation of the low apogee phenomena required a complete analysis of rocket aerodynamic characteristics. Machine tolerances on booster fin angle occasionally caused unstable flight dynamics which resulted in delayed separation of dart and motor. This delay added enough aerodynamic drag to the dart to significantly reduce apogee. The solution is to tighten shop tolerances during booster fin assembly [4].

Table 3 lists MRN stations; rockets launched, by type; and success rate. Failures by type and quantity are printed for each station, and summations for the entire MRN are listed at the bottom of the page. A two-sided test of significance is also printed at the bottom of the page and offers a quick-look determination of any change from a long-term average. Figure 2 is a pictorial representation of the percentage of failures attributable to the different failure modes, and figure 3 graphs the percent success by station and rocket type. There is a distinction between system success and station success. Systematic

failures include only those failures caused by a component malfunction (i.e., parachute, sonde, etc.), while station failures include both system malfunctions and loss of data because of ground station malfunction.

Each month's data is stored in a data base file, and this file is used periodically to compile cumulative statistics. Table 4 is the cumulative summary for the six-month period from October 1977 to March 1978. The format is similar to the monthly tabulation. One can quickly find the major trouble spots with each metrocket system. The PWN-8B had 37 failures caused by sonde cutoff at expulsion. The PWN-10A failed 20 times because of ranging problems. The PWN-11A had 36 sonde cutoff failures (the darts and instruments for the PWN-8B and PWN-11A are identical). The PWN-12A, an inflatable sphere, failed 18 times due to early collapse.

Figure 4 is similar to the monthly percent failure chart (figure 2), and shows at a glance where the major failure modes occur. Figure 5 plots the success rate by month for each rocket type. Two additional graphs are provided for each operating station success by month. Figures 6 and 7 illustrate monthly system success and station success rate, respectively, for the three types of metrockets flown at White Sands Missile Range.

The balance of this report is appendices A through C which include specific instructions for implementing the MRN system reliability program on a UNIVAC 1108 computer. Appendix A includes the instructions to stations for defining failure modes and coding the computer form. Appendix B describes the computer card input and UNIVAC 1100 EXEC commands for running the system reliably. Appendix C contains the MRN system reliability computer program designed for the UNIVAC 1108 computer.

CONCLUSION

From the formation of the MRN to 1977, there has been no formal, uniform procedure for reporting metrocket failures. In October 1977, the MRN system reliability program was initiated and has been providing valuable information to agency managers and station operators. To date, two major system deficiencies, sonde cutoff and low apogee, have been identified and corrected, which will result in the saving of thousands of dollars. Every single metrocket failure is tabulated, and trends can now be observed over long periods of time. Any new system problems can be quickly spotted and corrective action started immediately. This effort will result in a more efficient operation of the MRN at a significant reduction in cost.

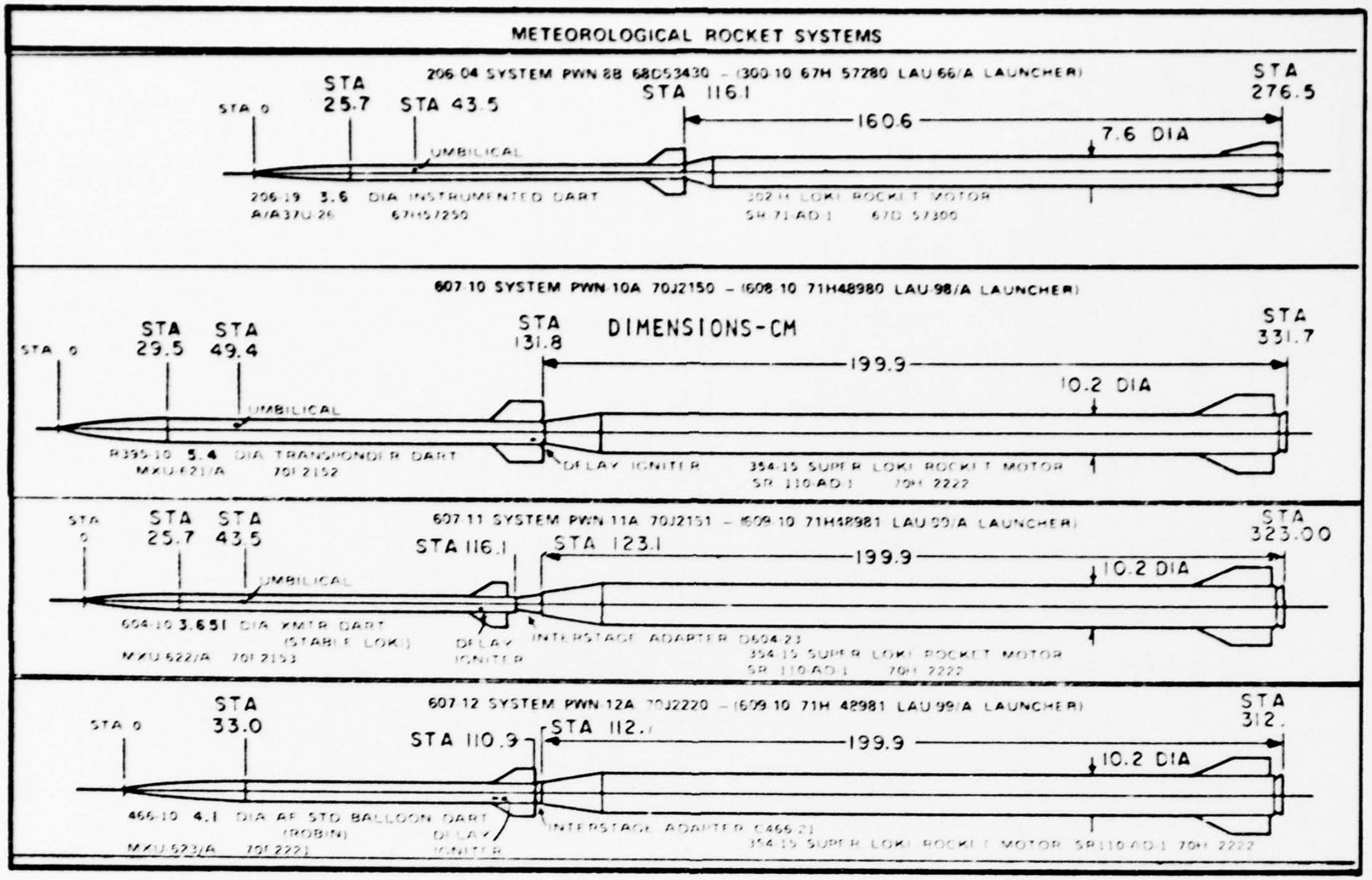

Figure 1. Meteorological rocket systems currently used by the MRN.

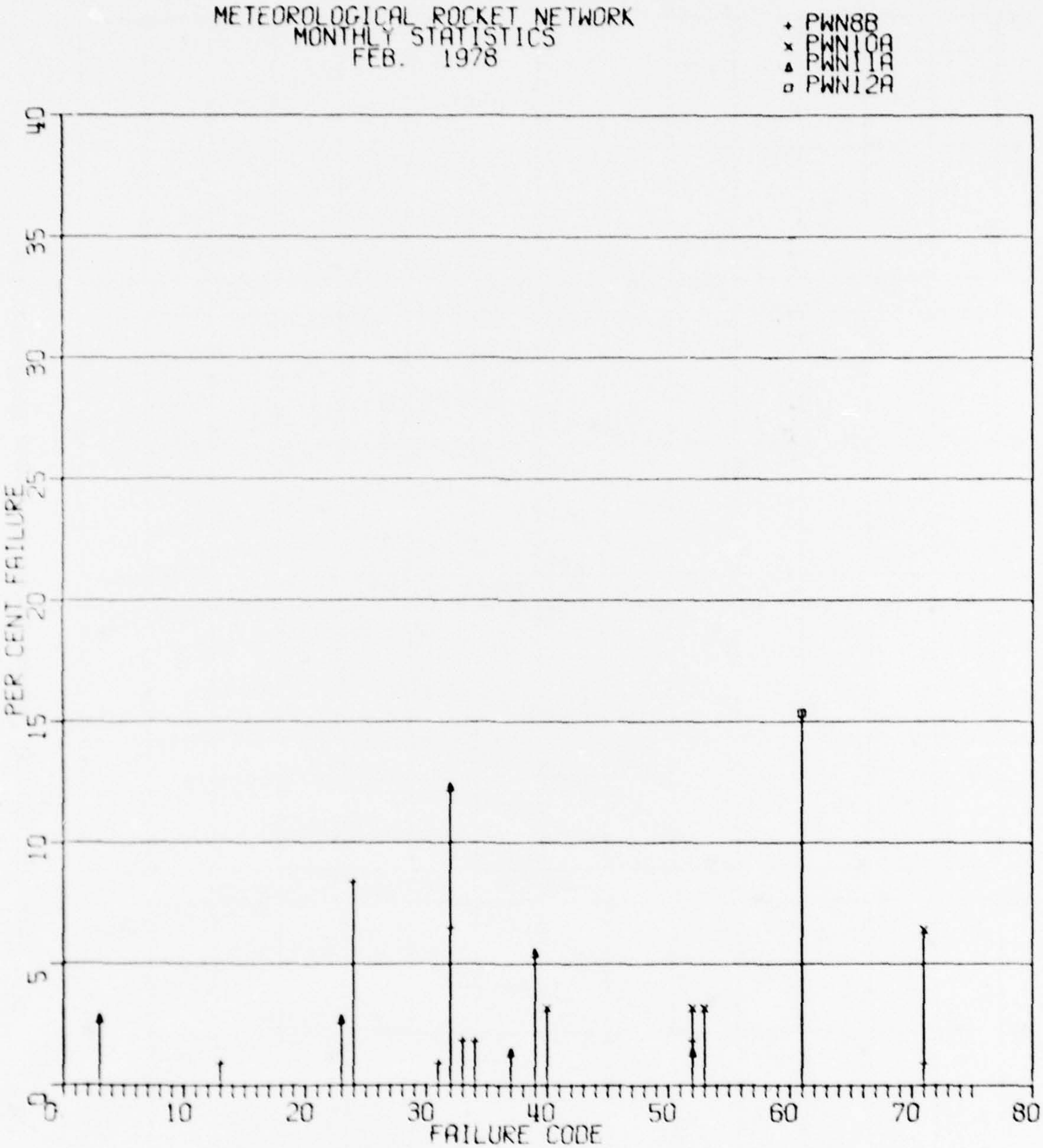

Figure 2. Monthly percent failure of rocket types as a function of failure mode. Mode definitions are listed in appendix A.

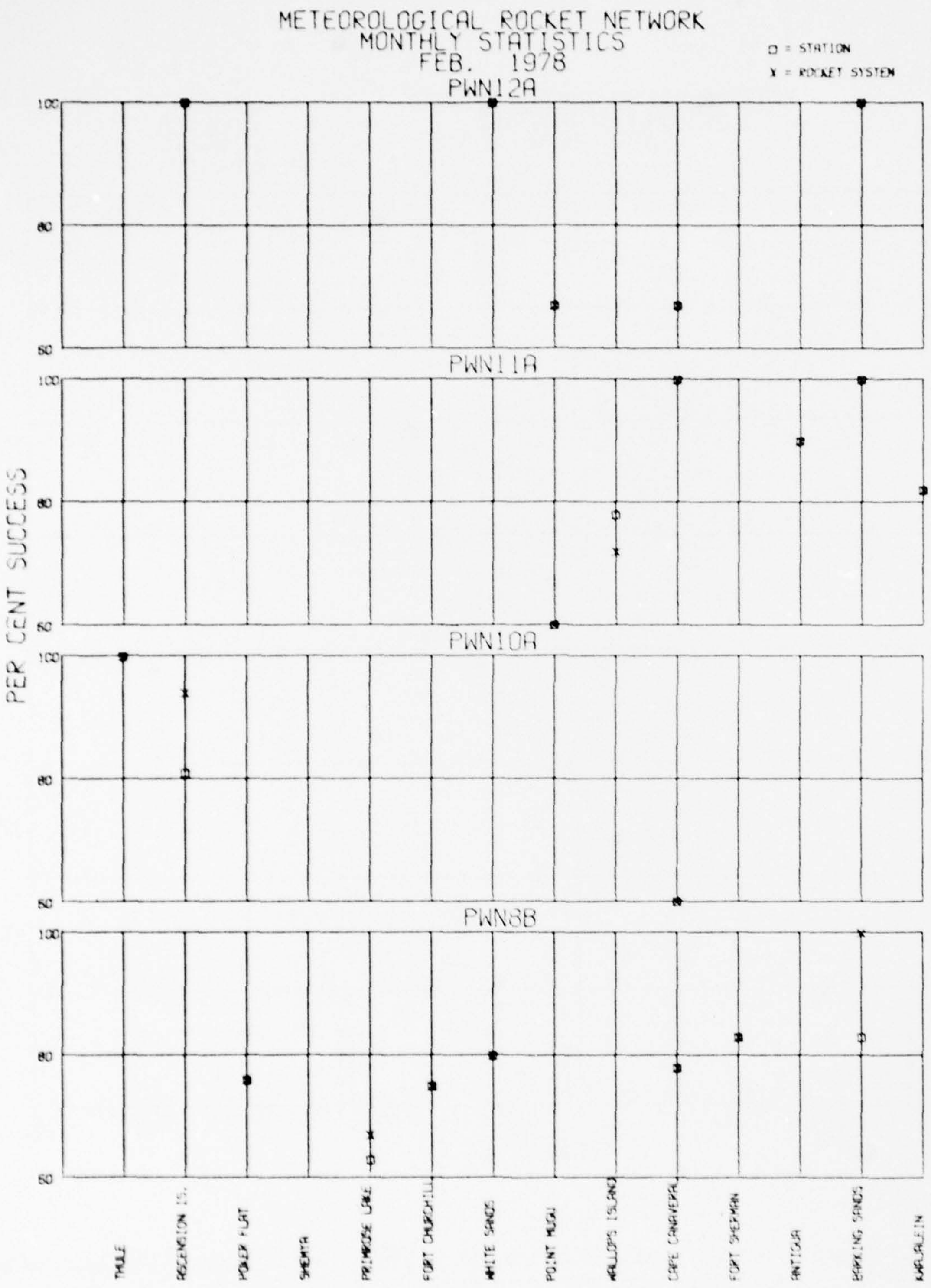

Figure 3. Monthly percent success by station and rocket type.

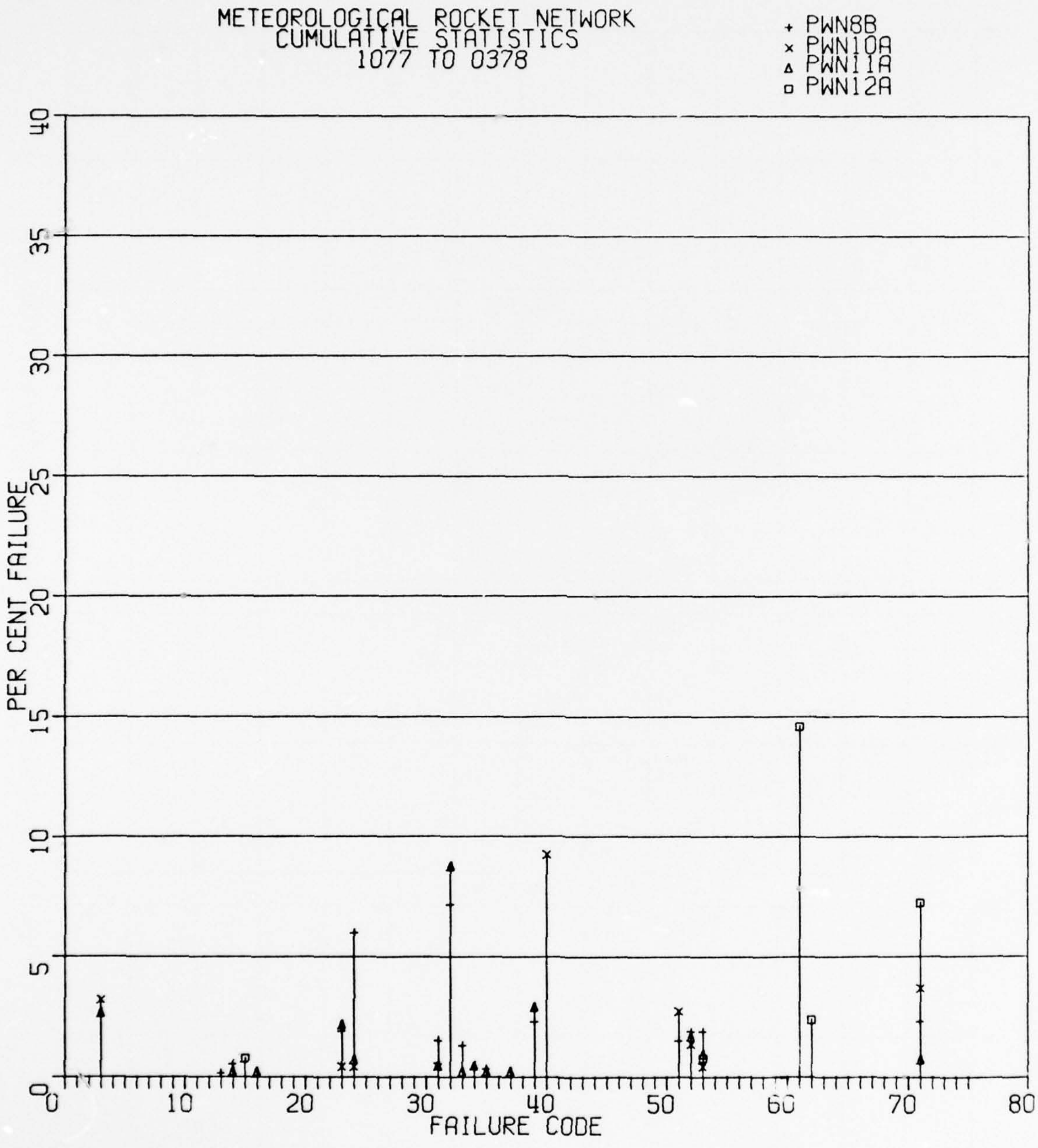

Figure 4. Six-month cumulative summary of percent failure of rocket types as a function of failure mode. Mode definitions are listed in appendix A.

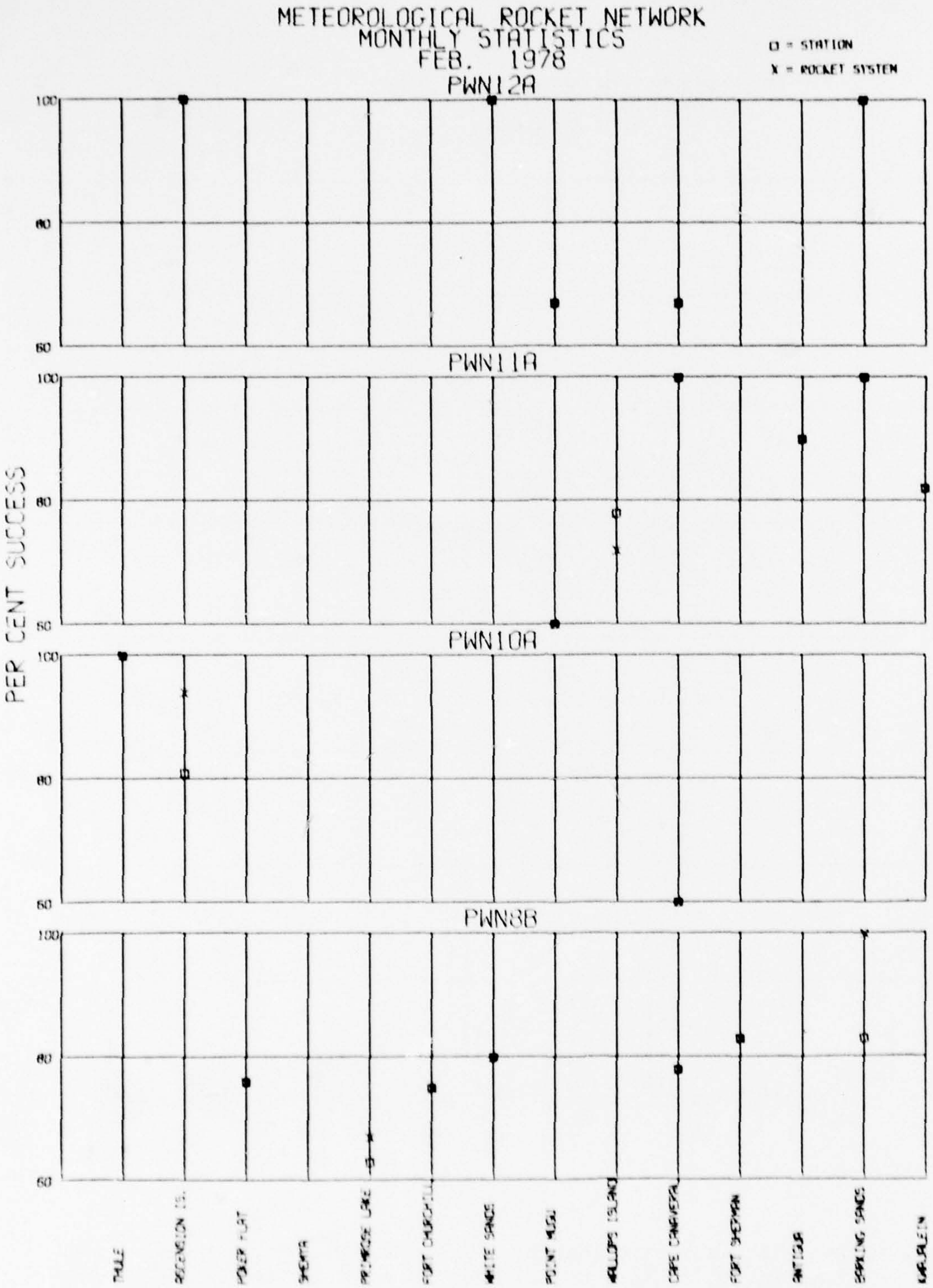

Figure 5. Six-month cumulative success rate for each rocket type.

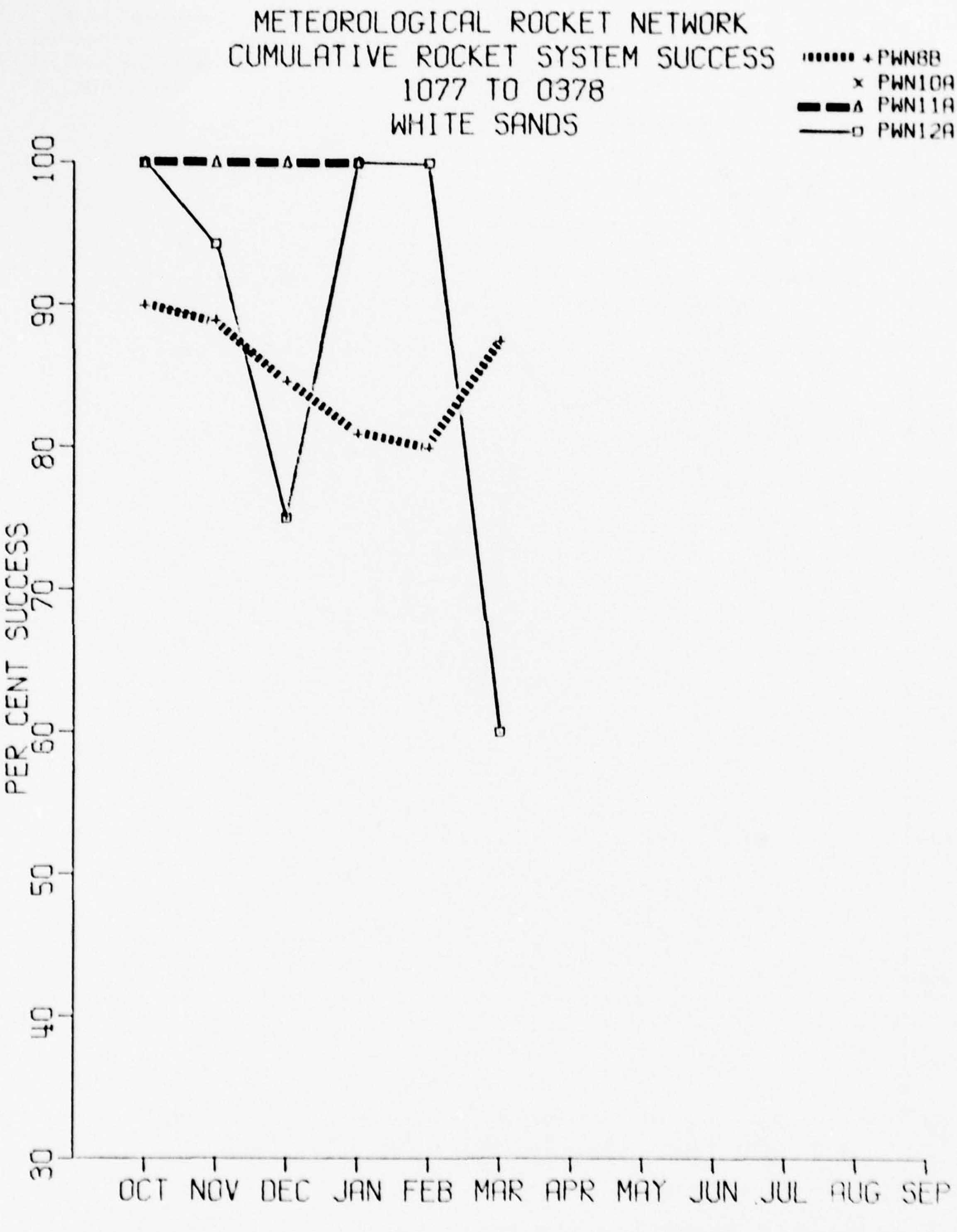

Figure 6. Six-month system success for rocket types flown at White Sands Missile Range, NM.

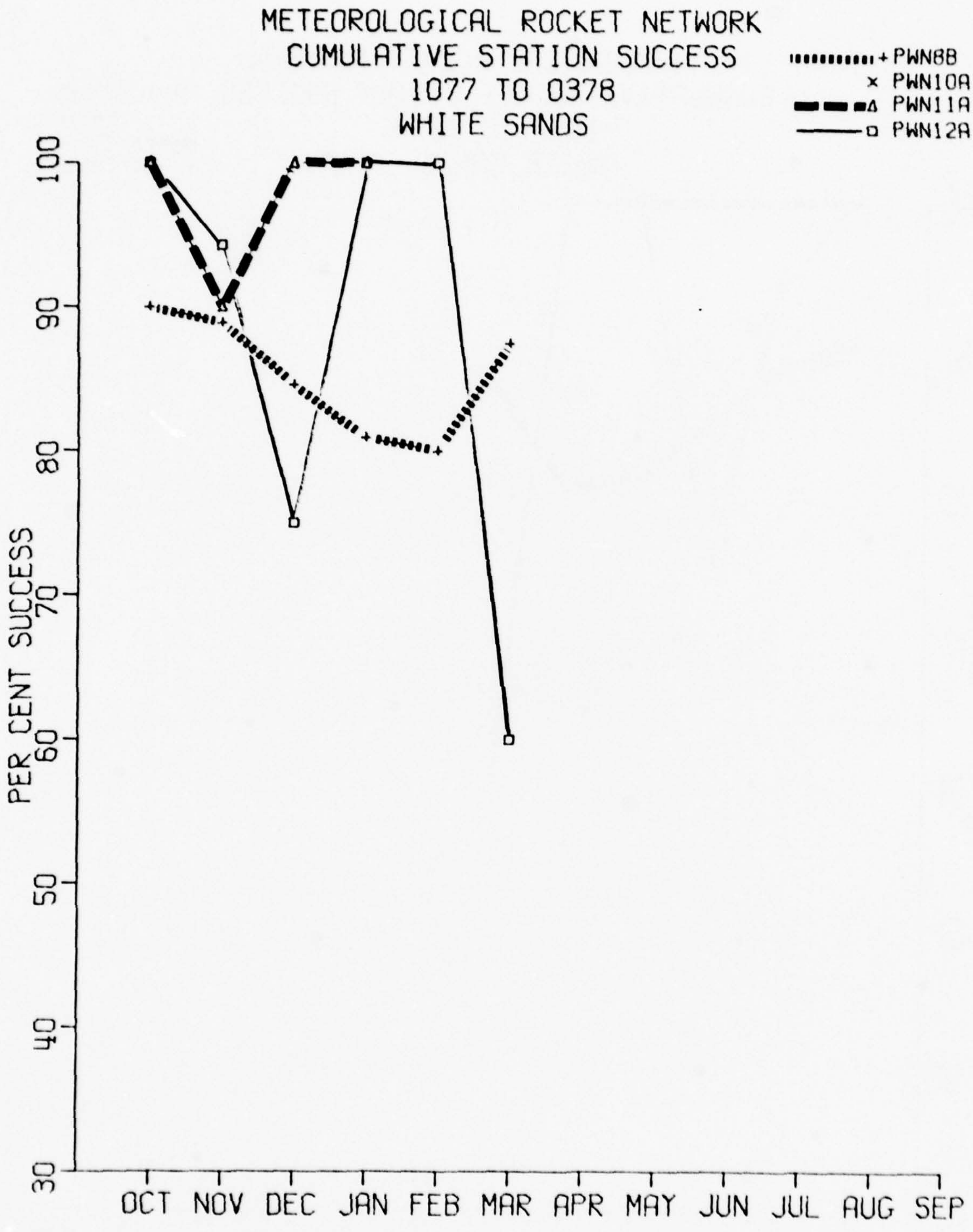

Figure 7. Six-month station success rate for rocket types flown at White Sands Missile Range, NM.

TABLE 1. METEOROLOGICAL ROCKET USAGE
OCTOBER 1977 - MARCH 1978

Station	Rocket Type			
	PWN-8B	PWN-10A	PWN-11A	PWN-12A
Thule, Greenland (USAF)		74		
Ascension I (USAF)		80	1	4
Poker Flat, AK (USA)	78		45	
Shemya, AK (USAF)		37		
Primrose Lake, Alta, Canada (USAF)	66			
Ft. Churchill, Man, Canada (USAF)	118			1
White Sands Missile Range, NM (USA)	89		20	58
Point Mugu, CA (Navy)			85	13
Wallops Island, VA (NASA)			64	5
Cape Canaveral, FL (USAF)	48	24	15	21
Ft. Sherman, C.Z. (USA)	77			
Antigua, BWI (USAF)			77	
Barking Sands, HI (Navy)	36		12	15
Kwajalein, MI (USA)			90	6
Total	512	215	409	123
Grand Total		1259		

TABLE 2. MONTHLY SUMMARY OF QUANTITY AND TYPE OF FAILURES, AND SERIAL NUMBERS OF METROCKET COMPONENTS

MONTHLY FAILURE SUMMARY

FEB. 1978

CODE	QUANTITY	MOTOR SN	LOT NO.	DART SN	DART FUZE SN	SONDE SN
3	2			3360		20162
				3366		20169
13	1	14011	132-1	14001	13768	20691
23	2	5358	79-8	1930	1922	17780
		5380	79-8	1932	1930	17782
24	9	14014	132-1	13994	13767	20683
		13726	2-105	13491	134[illegible]3	19693
		14640	135-1	14309	14309	21269
		14664	135-2	14347	14337	21293
		14026	132-1	13819	13682	20428
		13666	129-3	14117	14117	20971
		13604	129-2	14089	14097	20944
		13661	129-3	14112	14112	20965
		13663	129-3	14114	14114	20967
31	2	4455	74-7	1527	1527	1650
		13932	131-4	13815	13677	20424
32	16	13659	129-3	14109	14109	20962
		14137	2-109	13884	13884	20492
		14619	135-1	34401	34427	20867
		14591	134-7	34467	34437	20933
		14119	2-109	13493	13479	19695
		14104	2-109	13875	13889	20483
		7422	90-6	2927	2927	20563
		14134	2-109	13870	13861	20478
		5338	79-9	1938	1938	17788
		5231	79-5	1961	1921	17811
		5375	79-8	1922	1955	17772
		6015	83-2	317051	3422	17979
		8237	95-3	3385	3329	20186
		5356	79-8	1921	1953	17771
		5243	79-5	1962	1918	17812
		7207	90-1	2785	2711	20035
33	2	14015	132-1	13996	13768	20686
		13980	131-3	14007	13737	20697
34	2	14578	134-7	34472	34425	20938
		14579	134-7	34469	34428	20935
37	1	8235	95-3	1690-A	3321	17540A
39	4	8231	95-3	317053	3366	17981
		8239	95-3	317239	3369	18826
		5381	79-9	1928	1929	17778
		7227	90-1	2720	2799	19789
40	1	8100	94-1	1236	2108	1236
52	4	4969	78-5	2151	1954	2151
		14121	2-109	13494	13483	19696
		13978	131-5	14005	13735	20695
		7558	92-1	2691	2786	19761
53	1	8814	99-1	2425	1	2425
61	2	5246	79-5	983	983	R2494

TABLE 3. MONTHLY LIST OF STATION FIRING RATE, SUCCESS BY ROCKET TYPE, FAILURE MODE AND QUANTITY BY ROCKET TYPE. TWO-SIDED TEST OF SIGNIFICANCE IS INCLUDED.

NETWORK MONTHLY STATISTICS
FEB. 1978

	PWN8B TEST	SUCC	O/O	LAUN	SUCC	O/O	PWN10A TEST	SUCC	O/O	LAUN	SUCC	O/O	PWN11A TEST	SUCC	O/O	LAUN	SUCC	O/O	PWN12A TEST	SUCC	O/O	LAUN	SUCC	O/O
THULE	0	0	0	0	0	0	10	10	100	10	10	100	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE																								
ASCENSION IS.	0	0	0	0	0	0	16	15	94	16	13	81	0	0	0	0	0	0	2	2	100	2	2	100
TYPE FAILURE							1-52, 2-71,																	
POKER FLAT	25	19	76	25	19	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE	1-24, 4-32, 1-52,																							
PRIMROSE LAKE	15	10	67	16	10	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE	1-13, 1-24, 2-33, 1-52,																							
FORT CHURCHILL	20	15	75	20	15	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE	4-24, 1-32,																							
WHITE SANDS	20	16	80	20	16	80	0	0	0	0	0	0	0	0	0	0	0	0	4	4	100	4	4	100
TYPE FAILURE	2-32, 2-34,																							
POINT MUGU	0	0	0	0	0	0	0	0	0	0	0	0	19	11	58	19	11	58	3	2	67	3	2	67
TYPE FAILURE													2-23, 5-32, 1-39,						1-61,					
WALLOPS ISLAND	0	0	0	0	0	0	0	0	0	0	0	0	25	18	72	23	18	78	0	0	0	0	0	0
TYPE FAILURE													2-03, 2-32, 1-37, 2-39,											
CAPE CANAVERAL	9	7	78	9	7	78	5	3	60	5	3	60	1	1	100	1	1	100	3	2	67	3	2	67
TYPE FAILURE	2-24,						1-40, 1-53,												1-61,					
FORT SHERMAN	12	10	83	12	10	83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE	1-24, 1-31,																							
ANTIGUA	0	0	0	0	0	0	0	0	0	0	0	0	10	9	90	10	9	90	0	0	0	0	0	0
TYPE FAILURE													1-32,											
BARKING SANDS	6	6	100	6	5	83	0	0	0	0	0	0	1	1	100	1	1	100	1	1	100	1	1	100
TYPE FAILURE	1-71,																							
KWAJALEIN	0	0	0	0	0	0	0	0	0	0	0	0	17	14	82	17	14	82	0	0	0	0	0	0
TYPE FAILURE													1-32, 1-39, 1-52,											
TOTAL	107	83	78	108	82	76	31	28	90	31	26	84	73	54	74	71	54	76	13	11	85	13	11	85
TYPE FAILURE	1-13, 9-24, 1-31, 7-32,						1-40, 1-52, 1-53, 2-71,						2-03, 2-23, 9-32, 1-37,						2-61,					
TYPE FAILURE	2-33, 2-34, 2-52, 1-71,												4-39, 1-52,											
MEAN			79.8			76.8			84.6			80.4			83.7			84.8			86.7			86.7
SIGMA			9.5			6.6			17.6			16.3			15.1			14.5			16.3			16.3
LONG TERM MEAN				84.0						84.5						81.0						70.0		
SIGNIFICANT CHANGE?			NO			YES			NO			NO			NO			NO			YES			YES

TABLE 4. SIX-MONTH CUMULATIVE SUMMARY OF STATION FIRINGS, SUCCESS, AND FAILURE MODES.

CUMULATIVE NETWORK STATISTICS
1077 TO 0378

	..........PWN8B..........						..........PWN10A..........						..........PWN11A..........						..........PWN12A..........					
	TEST	SUCC	0/0	LAUN	SUCC	0/0	TEST	SUCC	0/0	LAUN	SUCC	0/0	TEST	SUCC	0/0	LAUN	SUCC	0/0	TEST	SUCC	0/0	LAUN	SUCC	0/0
THULE	0	0	0	0	0	0	74	67	91	73	66	90	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE							1-03, 4-40, 1-51, 1-52,																	
TYPE FAILURE							1-71,																	
ASCENSION IS.	0	0	0	0	0	0	80	67	84	80	64	80	1	1	100	1	1	100	4	4	100	4	2	50
TYPE FAILURE							1-24, 1-31, 6-40, 3-51,												2-71,					
TYPE FAILURE							2-52, 3-71,																	
POKER FLAT	78	50	64	78	50	64	0	0	0	0	0	0	45	38	84	45	38	84	0	0	0	0	0	0
TYPE FAILURE	1-14, 5-24, 1-31, 12-32,												1-16, 2-23, 1-32, 2-34,											
TYPE FAILURE	3-51, 5-52, 1-53,												1-52,											
SHEMYA	0	0	0	0	0	0	37	23	62	31	19	61	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE							6-03, 1-23, 6-40, 1-51,																	
TYPE FAILURE							4-71,																	
PRIMROSE LAKE	66	42	64	67	41	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE	1-13, 1-23, 2-24, 2-31,																							
TYPE FAILURE	9-32, 4-33, 2-39, 2-51,																							
TYPE FAILURE	1-52, 1-71,																							
FORT CHURCHILL	118	75	64	118	72	61	0	0	0	0	0	0	0	0	0	0	0	0	1	1	100	1	1	100
TYPE FAILURE	8-23, 19-24, 3-31, 3-32,																							
TYPE FAILURE	1-35, 4-39, 2-52, 8-53,																							
TYPE FAILURE	3-71,																							
WHITE SANDS	89	75	84	89	75	84	0	0	0	0	0	0	20	20	100	20	19	95	58	53	91	58	53	91
TYPE FAILURE	2-24, 7-32, 2-34, 1-36,												1-71,						1-53, 4-61,					
TYPE FAILURE	1-51, 1-52,																							
POINT MUGU	0	0	0	0	0	0	0	0	0	0	0	0	85	61	72	84	60	71	13	6	46	13	5	38
TYPE FAILURE													1-03, 6-23, 2-24, 1-31,						6-61, 1-62, 1-71,					
TYPE FAILURE													7-32, 1-33, 1-35, 4-39,											
TYPE FAILURE													1-53, 1-71,											
WALLOPS ISLAND	0	0	0	0	0	0	0	0	0	0	0	0	64	43	67	55	43	78	5	4	80	5	4	80
TYPE FAILURE													9-03, 1-24, 5-32, 1-37,						1-15,					
TYPE FAILURE													3-39, 2-53,											
CAPE CANAVERAL	48	36	75	48	35	73	24	18	75	24	18	75	15	13	87	15	13	87	21	18	86	21	14	67
TYPE FAILURE	1-23, 6-24, 1-32, 2-36,						4-40, 1-51, 1-53,						1-32, 1-52,						3-61, 4-71,					
TYPE FAILURE	2-51, 1-71,																							
FORT SHERMAN	77	61	79	77	56	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYPE FAILURE	2-14, 1-24, 1-31, 5-32,																							
TYPE FAILURE	3-33, 1-35, 2-39, 1-52,																							
TYPE FAILURE	5-71,																							
ANTIGUA	0	0	0	0	0	0	0	0	0	0	0	0	77	66	86	76	65	86	0	0	0	0	0	0
TYPE FAILURE													1-03, 7-32, 3-39, 1-71,											
BARKING SANDS	36	32	89	36	30	83	0	0	0	0	0	0	12	8	67	12	8	67	15	9	60	15	7	47
TYPE FAILURE	1-24, 1-31, 1-39, 1-53,												1-23, 3-32,						5-61, 1-62, 2-71,					
TYPE FAILURE	2-71,																							
KWAJALEIN	0	0	0	0	0	0	0	0	0	0	0	0	90	68	76	90	68	76	6	5	83	6	5	83
TYPE FAILURE													1-14, 1-31, 12-32, 2-39,						1-62,					
TYPE FAILURE													5-52, 1-53,											
TOTAL	512	371	72	513	359	70	215	175	81	208	167	80	409	318	78	398	315	79	123	100	81	123	91	74
TYPE FAILURE	1-13, 3-14, 10-23, 31-24,						7-03, 1-23, 1-24, 1-31,						11-03, 1-14, 1-16, 9-23,						1-15, 1-53, 18-61, 3-62,					
TYPE FAILURE	8-31, 37-32, 7-33, 2-34,						20-40, 6-51, 3-52, 1-53,						3-24, 2-31, 36-32, 1-33,						9-71,					
TYPE FAILURE	2-35, 12-39, 8-51, 10-52,						8-71,						2-34, 1-35, 1-37, 12-39,											
TYPE FAILURE	10-53, 12-71,												7-52, 4-53, 3-71,											

REFERENCES

1. "The Meteorological Rocket Network, IRIG," Meteorological Working Group, Document 111-64, Secretariat, Range Commanders Council, White Sands Missile Range, NM.

2. "Meteorological Rocket Observations," Federal Meteorological Handbook No. 10, National Aeronautics and Space Administration, US Department of Commerce, US Department of Defense, Washington, DC, July 1, 1975.

3. Luers, J. K., 1970, "A Method of Computing Winds, Density, Temperature, Pressure, and Their Associated Errors from the High Altitúde ROBIN Sphere Using an Optimum Filter," University of Dayton Research Institute, Dayton, OH.

4. Bollermann, B., 1978, "PWN-8B Loki Dart Low Altitude Problem," Space Data Corporation, Tempe, AZ.

APPENDIX A

METROCKET SYSTEM RELIABILITY INSTRUCTIONS AND GLOSSARY

METROCKET SYSTEM RELIABILITY

General

In past years, CMRN stations have had no uniform approach for recording and reporting metrocket system failure modes. As a result, CMRN reports have contained conflicting terms describing failures, and statistical compilations have been unreliable. In addition, the statistics have been compiled by agency representatives with no regular interchange of information. This section describes the process by which the CMRN can monitor the metrocket rate of success, identify modes of failure, and take corrective action.

A uniform glossary of terms, computer report form, and instructions are included. The computer report form will be submitted monthly by all CMRN stations to the following address:

US Army Atmospheric Sciences Laboratory
ATTN: Meteorological Rocket Coordinator
White Sands Missile Range, New Mexico 88002

After receipt, each submission will be key punched and processed with the CMRN system reliability program. Computer listings of processed statistical data will be forwarded to the Chairman, Subcommittee on Meteorological Rocket Observations (SMRO), and to agency CMRN managers.

Procedures

Computer Form. Each rocket system test will be entered on the system reliability computer report form.

A test is defined as (1) a metrocket firing, and (2) a preflight check that reveals a faulty system component. For example, if during the rocket assembly an igniter check reveals an open squib, this will be considered a test and entered on the computer form. It is possible to have more tests than firings.

Each test will be entered sequentially starting at the top line for the first test of the month. Information about each test will be entered in appropriate field data columns. Note: All entries are right justified in the data field.

Col 1-5, enter WMO station number

Example

1	2	3	4	5
0	4	2	0	2

Col 7-12, enter Greenwich date of test

Example:

	7	8	9	10	11	12
(Dec 1, 1976)	1	2	0	1	7	6
(Jan 1, 1977)	0	1	0	1	7	7

Col 13-18, enter time of launch, Greenwich time

Example:

13	14	15	16	17	18
		1	1	1	5

NOTE: If a prelaunch failure occurs, time may be left blank.

Col 19-24, enter type of rocket tested

Example:

19	20	21	22	23	24
	P	W	N	8	B
P	W	N	1	1	A

Col 25-30, enter dart serial number

Example:

25	26	27	28	29	30
		2	0	0	1
	1	5	2	9	4

Col 31-36, enter sonde serial number

Example:

31	32	33	34	35	36
		3	0	0	9
	1	9	2	4	8

Col 37-42, enter motor serial number

Example:

37	38	39	40	41	42
	1	1	6	3	2
		5	2	8	0

Col 43-48, enter tail fuze serial number

Example:

43	44	45	46	47	48
	1	3	7	4	2
		2	9	2	7

Col 49-54, enter manufacturer's lot number

Example:

49	50	51	52	53	54
	1	2	9	-	5
		8	9	-	5

NOTE: If a six-digit number is used, the hyphen may be omitted.

Col 55-60, enter date motor was loaded

Example:

55	56	57	58	59	60
		4	-	7	5
		6	-	7	7

Col 61-66, enter primary failure code

Example:

61	62	63	64	65	66
				0	0
				2	4

Primary failure is the initial malfunction causing loss of data. If a sonde quits at expulsion (code 32) and the apogee was very low (code 24), the low apogee would be the primary failure mode.

Col 67-72, enter secondary failure code

Example:

67	68	69	70	71	72
				2	2
				8	1

NOTE: Code 81 and 82 will appear only as a secondary failure mode. Columns may be left blank if failure does not occur.

GLOSSARY

Criteria for a Successful Meteorological Rocket Observation

A routine observation will be classified successful when 21 km or more of useful data for each parameter the system is designed to measure are obtained above 30 km for rocketsonde or transpondersonde and above 60 km for sphere. If these conditions are not met for any system launched or if a system or component fails on ground checkout, one of the following failure modes will be reported:

a. Success - Code 00

b. Prelaunch failure

Code	Failure Mode	Definition
01	Open squib (motor)	Measurement of squib resistance indicates open circuit.
02	Open squib (dart tail)	Measurement of squib resistance indicates open circuit.
03	Sonde malfunction	Sonde performance erratic, weak, no switching, no ranging, or otherwise unacceptable prior to launch.

NOTE: If a prelaunch failure occurs, launch time (Col 13-18) may be left blank.

c. Flight failures due to rocket motor:

11	Open squib	Failure of igniter to fire upon application of firing pulse.
12	No-fire misfire	Igniter fires but does not ignite motor propellant.
13	Hangfire	Motor propellant ignites but after some time delay.
14	Motor burnthrough	Motor ignites but burns through the motor casing. Failure may occur in launcher or in flight before dart separation.
15	Nonprogrammed	System does not take normal trajectory due to equipment failure.

Code	Failure Mode	Definition
16	Blowup	Motor explodes in launcher or during flight before dart separation.

d. Failures due to dart:

21	Premature expulsion	Sonde expelled more than 20 seconds before programmed expulsion time.
22	Late expulsion	Sonde expelled more than 20 seconds after programmed expulsion time.
23	No expulsion	Sonde failed to expel from dart.
24	Low apogee	Dart's apogee too low to meet success criteria; caused by dart hanging on to motor after motor burnout.

e. Failures due to sonde:

31	RF failure (sonde cutoff)	Sonde transmitter suddenly cuts off at motor ignition or during flight before payload expulsion.
32	RF failure, expulsion (sonde cutoff)	Sonde transmitter suddenly cuts off at payload expulsion from dart.
33	RF failure (sonde cutoff)	Sonde transmitter suddenly cuts off after payload expulsion.
34	RF failure (battery)	Sonde transmitter failure. Gradual weakening of transmitter signal due to battery failure.
35	Modulation failure	Sonde modulation ceases during or after expulsion resulting in no temperature or reference signal.
36	Broken thermistor	No modulation during temperature cycle; reference continues.
37	Missing references	Modulation for temperature continues during reference period; no interruption of temperature modulation occurs.

Code	Failure Mode	Definition
38	Missing temperature	Modulation for reference continues; no interruption of reference modulation occurs.
39	Thermistor cup stuck	Protective cup sticks on sonde after expulsion. Temperature resistance value changes very slowly. On TMQ-5 record ordinate value normally between 60-80 ord.
40	Ranging failure	82 kc signal received from sonde after expulsion is weak, noisy, or not transmitted by sonde.

f. Failures due to starute:

Code	Failure Mode	Definition
51	Fast fall rate	Excessive fall rate caused by failure or retardation device to properly inflate or stay inflated. Can be caused by stuck stave, and is recognized by accompanying stuck thermistor cup.
52	Damaged chute	Retardation device shows relatively normal fall rate, but TMQ-5 shows excessive telemetry dropouts; indicate abnormal oscillation and damage.
53	Retardation device breakup	Radar reports pieces departing from main target.

g. Failures of sphere system:

Code	Failure Mode	Definition
61	Premature collapse	Sphere descends to 38 km (125K feet) at launch plus 13 minutes or determined by visual observation of radar "A" scope and slow fall rate.
62	Incomplete inflation	Radar sees target that constantly changes, fall rate too slow.
63	Sphere breakup	Radar reports pieces departing main target.

Code	Failure	Definition
h. Failures due to ground equipment:		
71	Ground equipment/ support	Loss of data due to failure of ground equipment, personnel, facilities.
i. Other failures		
81	No tie-on	Radiosonde-rocketsonde temperature difference greater than 2.5° in overlap region. When these circumstances occur, code 81 will be entered as a secondary failure.
82	No corawinsonde	Corawinsonde data not available for tie-on. Code 82 will be entered as a secondary failure.

NOTE: If a secondary failure does not occur, leave columns 67-72 blank.

APPENDIX B

CARD INPUT AND UNIVAC 1100 EXEC COMMANDS FOR MRN SYSTEM RELIABILITY PROGRAM

The following pages describe the necessary card input information and UNIVAC 1100 EXEC commands to execute the MRN system reliability computer program at White Sands Missile Range, NM.

PROGRAM CONTROL CARD

COL.	NAME	FORMAT	DESCRIPTION
1-5	IØP	I5	If IØP=0, both the master file and data cards are input. The master file will be updated with the data cards for the month represented by those cards. If IØP=1, only cards are input and the master file is not referenced so it need not be assigned. If IØP=2 only the master file is input with no monthly data cards.
6-10	NCUM	I5	If NCUM=0 or blank, a monthly report will be generated for the specified month. If NCUM=1 a cumulative report will be computed for the months indicated. In this case (NCUM=1) IØP must be set to 0 or 2.
12-15	MY	A4	Month-year of monthly report to be computed. (For example, "January 1978" is input as "0178.")
16-20	MYI	I5	Month-year of first month to use for cumulative report. (Right justified)
21-25	MYJ	I5	Month-year of last month to use for cumulative report. (Right justified)
26-30	NMØS	I5	Number of months for which cumulative report is wanted. (Cannot be greater than 12)

EXECUTION SETUP

Below are described the necessary UNIVAC 1100 EXEC commands to execute the program.

CASE 1: (For monthly report with card only input)

```
    @ASG,AZ        SERNA*MRQC
    @ASG,T         10., T, CØ101U (plot tape)
    @MSG,W         CØ101U Name= ---, Pan = ---, Bldg 1623
    @XQT           SERNA*MRQC.ABS

            Program Control Card (with IØP=1, NCUM=0 Data Cards)

    @FIN
```

CASE 2: (For monthly report with card input and to update Master File)

```
    @ASG,AZ        SERNA*MRQC
    @ASG,AZ        SERNA*MRQCFILE.
    @ASG,AZ        SERNA*MRQCFILE2.
    @USE           1., SERNA*MRQCFILE.
    @USE           2., SERNA*MRQCFILE2.
    @ASG,T         10., T, CØ101U
    @MSG,W         CØ101U  Name= ----, Pan = ----, Bldg. 1623
    @XQT           SERNA*MRQC.ABS

            Program Control Card (with IØP=0, NCUM=0 Data Cards)

    @FIN
```

In this case SERNA*MRQCFILE would have the current data and SERNA*MRQCFILE 2 will have the data from SERNA*MRQCFILE updated with the information from the input data cards for the new reporting month. These two files should be used as "Flip-flops"; so then, on a subsequent update run SERNA*MRQCFILE2 is equivalenced to file 1, and SERNA*MRQCFILE is equivalenced to file 2., etc. The file equivalenced to 1. will remain as input. All the information from "1." is transferred to "2." and the new monthly data is added to "2."

CASE 3: (For cumulative report)

```
    @ASG,AZ        SERNA*MRQC
    @ASG,AZ        SERNA*MRQCFILE. (or SERNA*MRQCFILE2 depending on
                                   which of the two contains the infor-
                                   mation for MYI through MYJ)
    @USE           1., SERNA*MRQCFILE: (or as above)
    @ASG,T         10., T, CØ101U
    @MSG,W         CØ101U  Name = ----, Pan = ----, Bldg 1623
    @XQT           SERNA*MRQC.ABS

            Program Control Card (with IØP=2, NCUM=1)

    @FIN
```

MASTER FILE DESCRIPTION

SERNA*MRQCFILE and SERNA*MRQCFILE2 are set up to use as "flip-flop" Master Files but any other files could be used as Master Files. The Master File is used as a direct access file and is described below.

The file consists of a variable number of sectors. Sectors 0 through 6 contain directory information. The first word in sector 0 has the total number of sectors of data in the file (not including directory information) in the top half word and the total number of months for which there are data entries in the bottom half word. The rest of sector 0 has 8 sets of 3 words each consisting of month-year, number of first sector, number of last sector, respectively, for each of the first 8 month-year data sets. Sectors 1 through 6 contain similar 3 word sets for the next 9 through 16, 17 through 24, etc., month-year data sets. Thus, directory information can exist for a maximum of 56 months. The figure below might serve to clarify the previous statements.

SECTOR 0

# SECTORS	# MONTHS	NDATE(1)	NFR(1)	NLR(1)	. . .	NDATE(8)	NFR(8)	NLR(8)

WORD 1 WORD 25

SECTOR 1

NDATE(9)	NFR(9)	NLR(9)	. . .	NDATE(16)	NRF(16)	NLR(16)

WORD 1 WORD 24

. . .

. . .

. . .

SECTOR 6

NDATE(49)	NFR(49)	NLR(49)	. . .	NDATE(56)	NFR(56)	NLR(56)

WORD 1 WORD 24

The rest of the file contains the card input monthly data, two data card entries per sector in words 1 through 12 and words 13 through 24, respectively.

APPENDIX C
COMPUTER PROGRAM FOR MRN SYSTEM RELIABILITY
UNIVAC 1108

```
13      SERNA*MRQC   MFUPDT

          SUBROUTINE MFUPDT(IDATE,NENTRY)
          COMMON/DBLOK/NDTA(500,12),IOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
         1          IFCOD(50),NSTAT,NROCK,NCODE,PDATE(2),MYI,MYJ,NCUM
          COMMON/DIR/IRSTAT,NUMREC,NUMON,NDATE(60),NFR(60),NLR(60)
          DIMENSION SECT(28)
          DATA IFILL/07777777777777/ , NUMREC/0/ , NUMON/0/ , NFR/60*0/,
         1   NLR/60*0/ , NDATE/60*0/ , NCON/0/
          CALL SETADR(LU,0)
          CALL SETADR(LUO,0)
          IRSTAT=1
          ZERO=0.
          READ(LU,END=100,ERR=100)NCON,(NDATE(J),NFR(J),NLR(J),J=1,8)
          NUMREC = FLD(0,18,NCON)
          NUMON = FLD(18,18,NCON)
          JF=9
          JL=16
          DO 50 I=1,6
          READ(LU)(NDATE(J),NFR(J),NLR(J),J=JF,JL),DUM
          JF=JF+8
          JL=JL+8
   50     CONTINUE
  100     CONTINUE
          NR=NUMREC
          N=NUMON
          M=N
          IF(N.EQ.0)M=1
          NUMON=NUMON + 1
          NDATE(N+1)=IDATE
          IF(NLR(1).EQ.0) NLR(1)=6
          NFR(N+1)=NLR(M)+1
          NLR(N+1)=NFR(N+1)+(NENTRY+1)/2 -1
          NUMREC= NUMREC + NLR(N+1)-NFR(N+1)+1
          FLD(0,18,NCON) = NUMREC
          FLD(18,18,NCON) = NUMON
          WRITE(LUO)NCON,(NDATE(J),NFR(J),NLR(J),J=1,8)
          JF=9
          JL=16
          DO 150 I=1,6
          WRITE(LUO) (NDATE(J),NFR(J),NLR(J),J=JF,JL),IFILL
          JF=JF+8
          JL=JL+8
  150     CONTINUE
          IF(NR.LE.0) GOTO 210
          DO 200 I=1,NR
          READ(LU )(SECT(J),J=1,25)
          WRITE(LUO)(SECT(J),J=1,25)
  200     CONTINUE
  210     CONTINUE
          DO 300 I=1,NENTRY,2
          I1=I
```

```
13      SERNA*MRQC   MFUPDT

              I2=I+1
              WRITE(LUO)((NDTA(K,J),J=1,12),K=I1,I2),IFILL
      300     CONTINUE
              RETURN
              END
```

```
C••      THIS CODE IS USED IN THE QUALITY CONTROL PROGRAM TO
C••      CONTINUALLY MONITOR THE METROCKET RATE OF SUCCESS AT ALL
C••      CMRN STATIONS. THE PROBLEM AND THE GENERATED REPORTS
C••      WERE DEFINED BY BRUCE KENNEDY OF ASL-WSMR.
C••      THE COMPUTER CODE WAS DEVELOPED BY JOSE' SERNA OF PSL-NMSU
C••      UNDER CONTRACT TO ASL.
C••
      INTEGER STATN,TDATE,RTYPE,DSN,SSN,DFSN,OLDED,PFCD,SFCD,STATCD,
     1       STATID,TFAIL,ROCKID,BLANK,PCNTT,PCNTL,TPCNTT,TPCNTL
     2 ,TLNCH,TLSUCC,TOTTST,TOTSUC,TOTT,TOTS,TLSU,TLNC
      COMMON/DBLOK/NDTA(500,12),IOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
     1         IFCOD(50),NSTAT,NROCK,NCODE,PDATE(2),MYI,MYJ,NCUM
      DIMENSION STATN(500),TDATE(500),LTIME(500),RTYPE(500),DSN(500),
     1        SSN(500),MSN(500),DFSN(500),MLN(500),OLDED(500),
     2        PFCD(500),SFCD(500),INS(4),STPCNT(12,4),SYPCNT(12,4),
     3 XMONTH(12,4),LMNTH(12),CSTPCT(12,4),CSYPCT(12,4),CXMNTH(12,4)
       DIMENSION TLNC(4),TLSU(4),TOTT(4),TOTS(4),NF(50,4)
     1 ,INSFLG(4), NSAVE(4,4),SUM1(4),SUM2(4),SUMSQ1(4),SUMSQ2(4)
     2  ,SMEAN1(4),SMEAN2(4),SIGMA1(4),SIGMA2(4),RNST(4),T95(20)
     3   ,RLTMN(4),SIGT(8),RMU(8),DIFFMN(8),SMONTH(12,4)
      EQUIVALENCE (NDTA(1,1),STATN(1)),(NDTA(1,2),TDATE(1)),
     1(NDTA(1,3),LTIME(1)),(NDTA(1,4),RTYPE(1)),(NDTA(1,5),DSN(1)),
     2(NDTA(1,6),SSN(1)),(NDTA(1,7),MSN(1)),(NDTA(1,8),DFSN(1)),
     3(NDTA(1,9),MLN(1)),(NDTA(1,10),OLDED(1)),(NDTA(1,11),PFCD(1)),
     4(NDTA(1,12),SFCD(1))
C
      DIMENSION LIST(50,4),TFAIL(50,4),NMNTH(12),NLNCH(4),NSUCC(4),
     1       NTST(4),PCNTT(4),PCNTL(4),STATID(3,15),TOTTST(12,4),
     2  TOTSUC(12,4),TLNCH(12,4),TWO71(4),YPCNT(15,4,2),XSTAT(15,4),
     3        PCNTF(4,50),TPCNTT(4),TPCNTL(4),LSUCC(4),TLSUCC(12,4)
      DATA IFCOD/00,01,02,03, 11,12,13,14,15,16, 21,22,23,24,
     1  31,32,33,34,35,36,37,38,39,40,51,52,53,61,62,63,71,72,18*0/
C
      DATA STATCD/04202,61902,70192,70414,71124,71913,72269,72391,
     1             72402,74794,78801,78861,91162,91366,0/
      DATA STATID/6H THULE,6H      ,6H      ,6H ASCEN,6HSION I,6HS.    ,
     1             6H POKER,6H FLAT ,6H      ,6H SHEMY,6HA     ,6H      ,
     2             6H PRIMR,6HOSE LA,6HKE    ,6H FORT ,6HCHURCH,6HILL   ,
     3             6H WHITE,6H SANDS,6H      ,6H POINT,6H MUGU ,6H      ,
     4             6H WALLO,6HPS ISL,6HAND   ,6H CAPE ,6HCANAVE,6HRAL   ,
     5             6H FORT ,6HSHERMA,6HN     ,6H ANTIG,6HUA    ,6H      ,
     6             6H BARKI,6HNG SAN,6HDS    ,6H KWAJA,6HLEIN  ,6H      ,
     7             6H      ,6H      ,6H      /, BLANK/6H      /
      DATA ROCKID/6H PWN8B ,6HPWN10A,6HPWN11A ,6HPWN12A/
C
      DATA NMNTH/6HJAN.  ,6HFEB.  ,6HMARCH ,6HAPRIL ,6HMAY   ,6HJUNE  ,
     1           6HJULY  ,6HAUG.  ,6HSEPT. ,6HOCT.  ,6HNOV.  ,6HDEC.  /
C
      DATA T95/6.314,2.920,3.353,2.132,2.015,1.943,1.895,1.860,
     1    1.833,1.812,1.796,1.782,1.771,1.761,1.753,1.746,
```

```
      2     1.740,1.734,1.729,1.726/
       DATA RLTMN/ 84.0,84.5,81.0,70.0/
C
       NCODE=32
       NSTAT=14
       NROCK=4
       LU=01
       LUO=2
       LUS=13
       IMNTH=0
C**        READ PROGRAM CONTROL CARD
       READ(5,900) IOP,NCUM,MY,MY1,MYJ,NMOS
       DECODE(6,915,MY) MONTH
       IDATE=MY
C**        IOP=0  MASTERFILE AND CARDS ARE INPUT
C**        IOP=1  CARDS ONLY ARE INPUT
C**        IOP=2  MASTERFILE ONLY IS INPUT
       IF(IOP.EQ.2) GOTO 100
       CALL READC(IMNTH,NENTRY)
       IF(IOP.EQ.1) GOTO 120
C**        READC ROUTINE IS CALLED TO READ CARD INPUT ENTRIES
C**        MFUPDT IS CALLED TO UPDATE THE MASTER FILE
       CALL MFUPDT(IDATE,NENTRY)
       IF(NCUM.EQ.3) GOTO 750
100    CONTINUE
       IF(NCUM.NE.0) GOTO 150
       NMOS=1
       IF(IMNTH.EQ.MONTH) GOTO 120
C**        IF MONTH FOR CARD INPUT ENTRIES (IMNTH) IS THE
C**        SAME AS THAT DESIRED FOR REPORT (MONTH) INFO IS ALREADY
C**        IN ARRAY NDTA SO NEED NOT ACCESS MASTER FILE AT THIS TIME
C**
C**        OTHERWISE CALL READF TO GET INFO FOR MONTH (MONTH)
C**
       CALL READF(IDATE,NENTRY,NCUM,KFLAG)
       IF(KFLAG.EQ.1) GOTO 800
120    CONTINUE
C**        CALL SORT ROUTINE TO SORT DATA BY PRIMARY FAILURE CODE
C**
       IF(NMOS.EQ.0) NMOS=1
       CALL SORT(NDTA,1,11,NENTRY,12)
       DECODE(6,910,IDATE) IYR
       WRITE(6,920) NMNTH(MONTH),IYR
C**
C**        DO 140 STARTS LOOP TO GENERATE FAILURE SUMMARY REPORT
C**
       DO 140 I=2,NCODE
       CALL SEARCH(PFCD,NENTRY,IFCOD(I),NPNT,M)
       IF(M.LE.0) GOTO 140
       N=NPNT
```

```
      WRITE(6,930) IFCOD(I),M,MSN(N),MLN(N),DSN(N),DFSN(N),SSN(N)
C**
      IF(M.LE.1) GOTO 140
C**
      DO 130 J=2,M
      N= J + NPNT - 1
130   WRITE(6,935) MSN(N),MLN(N),DSN(N),DFSN(N),SSN(N)
C
140   CONTINUE
150   CONTINUE
      MSTRT=MYI/100
      MEND=MYJ/100
C**********NEED TOTTST,TOTSUC, TLNCH AND TFAIL FOR 4 ROCKET TYPES OUT OF 400 LOOP
      N=MSTRT
C**        LMNTH IS ARRAY OF MONTH LABELS FOR PLOT
      DO 160 I=1,12
      LMNTH(I)= NMNTH(N)
      N=N+1
160   N= N - N/13*12
      DO 170 I=1,4
      DO 165 IM=1,12
      TOTTST(IM,I)=0
      TLSUCC(IM,I)=0
      TAO71(I)=0.
      TOTSUC(IM,I)=0
      TLNCH(IM,I)=0
      CSTPCT(IM,I)=0
      CSYPCT(IM,I)=0
      SMONTH(IM,I)=0
165   CXMNTH(IM,I)=0
      SUM1(I)=0
      SUM2(I)=0
      SUMSQ1(I)=0
      SUMSQ2(I)=0
      RNST(I)=0.
      TOTT(I)=0
      TOTS(I)=0
      TLNC(I)=0
      TLSU(I)=0
      INS(I)=0
      DO 170 J=1,30
170   TFAIL(J,I)=0
      DO 175 I=1,15
      DO 175 J=1,4
      YFCNT(I,J,1)=0.
      YFCNT(I,J,2)=0.
175   CONTINUE
C**
      IF (NCUM.NE.0) GOTO 190
      REWIND LUS
```

```
              WRITE(6,9998)
        9998  FORMAT(1H1)
              DO 180 I=1,NENTRY
              READ(LUS)( NDTA(I,J),J=1,12)
              WRITE(6,9999) (NDTA(I,J),J=1,12)
        9999  FORMAT(    2X,I6,3A6   ,6A6,2J2)
        180   CONTINUE
        190   CONTINUE
        C     IF(NCUM.NE.0)DECODE(6,910,TDATE) IYR    ...NEED TO CHANGE...
              ENCODE(10,995,PDATE) NMNTH(MONTH),IYR
              IF(NCUM.EQ.0) WRITE(6,940) NMNTH(MONTH),IYR
              IF(NCUM.GT.0) WRITE(6,945) MYI,MYJ
              WRITE(6,950) (ROCKID(IR),IR=1,4)
              WRITE(6,960)
        C**
        C**         DO 400 BEGINS LOOP TO GENERATE NETWORK MONTHLY STATISTIC REP.
        C**
        C**
        C             CALL INITAL WITH 400 FOR LARGE PLOTTER (DP-7)
        C             CALL INITAL WITH 200 FOR SMALL PLOTTER (DP-5)
        C**
              CALL INITAL(10,400,11,0.,0,0)
              DO 400 I=1,NSTAT
              JDATE=MYI
        C**
              DO 200 IR=1,4
              DO 195 IM=1,12
              STPCNT(IM,IR)=0
              SYPCNT(IM,IR)=0
        195   XMONTH(IM,IR)=0
              INSFLG(IR)=0
              NSAVE(1,IR)=0
              NSAVE(2,IR)=0
              NSAVE(3,IR)=0
              NSAVE(4,IR)=0
              PCNTT(IR)=0
              PCNTL(IR)=0
              NLNCH(IR)=0
              LSUCC(IR)=0
              TR071(IR)=0.
              NSUCC(IR)=0
              NTST(IR)=0
              DO 200 KL=1,NCODE
              LIST(KL,IR)=6H
              NF(KL,IR)=0
        200   CONTINUE
              DO 272 IM=1,NMOS
        C**
              IF(NCUM.EQ.0)GOTO 205
              CALL READF(JDATE,NENTRY,NCUM,KFLAG)
```

```
      IF(KFLAG.GT.0) GO TO 800
      JDATE=JDATE+ 100
      IF(JDATE.GT.1300) JDATE=JDATE-1200+1
  205 CONTINUE
      CALL SEARCH(STATN,NENTRY,STATCD(I),NPNT,M)
      IF(M.LE.0.AND.NCUM.LE.0) GOTO 400
      IF(M.LE.0) GOTO 272
      DO 270 K=1,4
      CALL SEARCH(RTYPE(NPNT),M,ROCKID(K),NP,MM)
      NP=NP+NPNT-1
      IF(MM.LE.0) GOTO 270
C**
      RNST(K)=RNST(K)+1.
      DO 220 KT=1,MM
      IF(LTIME(NP+KT-1).EQ.6H      ) GOTO 220
      IF(PFCD(NP+KT-1).EQ.01) GOTO 220
      IF(PFCD(NP+KT-1).EQ.02) GOTO 220
      IF(PFCD(NP+KT-1).EQ.03) GOTO 220
      NLNCH(K)=NLNCH(K) + 1
      TLNCH(IM,K)=TLNCH(IM,K) + 1
  220 CONTINUE
C**
      DO 260 J=1,NCODE
      CALL SEARCH(PFCD(NP),MM,IFCOD(J),NPP,MMM)
      NPP=NPP+NP-1
      IF(MMM.LE.0) GOTO 260
       NTST(K)=NTST(K) + MMM
       TOTTST(IM,K)=TOTTST(IM,K) + MMM
      IF(IFCOD(J).NE.71) TW071(K)=TW071(K)+MMM
      IF(IFCOD(J).EQ.0) GOTO 230
      IF(IFCOD(J).EQ.71) GOTO 240
  225 TFAIL(J,K)=TFAIL(J,K ) + MMM
      NF(J,K)=NF(J,K)+MMM
      GOTO 260
  230 LSUCC(K)=LSUCC(K) + MMM
      TLSUCC(IM,K) = TLSUCC(IM,K) + MMM
  240 NSUCC(K)=NSUCC(K) + MMM
      TOTSUC(IM,K) = TOTSUC(IM,K) + MMM
      IF(IFCOD(J).EQ.71) GOTO 225
  260 CONTINUE
      INSFLG(K)=1
      RLS=LSUCC(K)- NSAVE(1,K)
      NSAVE(1,K)=LSUCC(K)
      RNS=NSUCC(K)- NSAVE(2,K)
      NSAVE(2,K)=NSUCC(K)
      RNL=NLNCH(K)- NSAVE(3,K)
      NSAVE(3,K)=NLNCH(K)
      RNT=NTST(K)- NSAVE(4,K)
      NSAVE(4,K)=NTST(K)
      STPCNT(IM,K)= RLS/RNL * 100.
```

```
            SYPCNT(IM,K)= RNS/RNT * 100.
            XMONTH(IM,K)= IM
            SMONTH(IM,K)= IM
      C**
  270       CONTINUE
  272       CONTINUE
            DO 275 K=1,4
            RLS=LSUCC(K)
            RNS=NSUCC(K)
            RNL=NLNCH(K)
            RNT=NTST(K)
            JNS=INS(K)
            RP1= RNS/ RNT*100.
            RP2= RLS/ RNL *100.
            PCNTT(K)= RP1 + .5
            PCNTL(K)= RP2 + .5
            SUM1(K)=SUM1(K) + RP1
            SUMSQ1(K)=SUMSQ1(K) + RP1*RP1
            SUM2(K)=SUM2(K) + RP2
            SUMSQ2(K)=SUMSQ2(K) + RP2*RP2
            IF(INSFLG(K).EQ.0) GOTO 275
            INS(K)=INS(K)+1
            JNS=INS(K)
            XSTAT(JNS,K)=FLOAT(I)*.5
            YPCNT(JNS,K,1)= PCNTL(K)
            YPCNT(JNS,K,2)= PCNTT(K)
  275       CONTINUE
            WRITE(6,980)(STATID(ID,I),ID=1,3),(NTST(IS),NSUCC(IS),PCNTT(IS),
           1               NLNCH(IS),LSUCC(IS),PCNTL(IS), IS=1,4)
      C**
            MAXF=0
            DO 280 IR=1,4
            L=0
            DO 280 JC=1,NCODE
            IF(NF(JC,IR).LE.0) GOTO 280
            L=L + 1
            IF(L.GT.MAXF) MAXF=L
            ENCODE(6,970,LIST(L,IR)) NF(JC,IR), IFCOD(JC)
  280       CONTINUE
      C*****
            DO  300 IB=1,MAXF,4
             IE= IB+3
  300        WRITE(6,990) ((LIST(I1,I2), I1=IB,IE),I2=1,4 )
      C**
            IF(NCUM.EQ.0) GOTO 400
            CALL PLOT3(XMONTH,STPCNT,SYPCNT,LMNTH,STATID(1,I))
  400       CONTINUE
      C**
            DO 450 J=1,4
            DO 445 IM=1,NMOS
```

```
            TOTT(J)=TOTT(J) + TOTTST(IM.J)
            TOTS(J)=TOTS(J) + TOTSUC(IM.J)
            TLNC(J)=TLNC(J) + TLNCH(IM.J)
            TLSU(J)=TLSU(J) + TLSUCC(IM.J)
    445     CONTINUE
            DO 450 K=1.NCODE
            LIST(K.J)=6H
            RTF=TFAIL(K.J)
            RTO=TOTT(J)
    450     PCNTF(J.K)=RTF/RTO*100.
    C       XSTAT(1)=.5
    C       DO 470 I=2.13
    C470     XSTAT(I)=XSTAT(I-1)+.5
            MAXF=0
            DO 480 I=1.4
            DO 475 IM=1.NMOS
            CSTPCT(IM.I)= REAL(TLSUCC(IM.I))/REAL(TLNCH(IM.I)) * 100.
    475     CSYPCT(IM.I)= REAL(TOTSUC(IM.I))/REAL(TOTTST(IM.I)) * 100.
            FLAN=TLNC(I)
            FSUC=TOTS(I)
            FLSUC=TLSU(I)
            FTST= TOTT(I)
            L=0
            TPCNTT(I)= FSUC/FTST*100. + .5
            TPCNTL(I)= FLSUC/FLAN*100. + .5
            DO 480 J=1.NCODE
            IF(TFAIL(J.I).EQ.0)GOTO 480
            L=L+1
            IF(L.GT.MAXF)MAXF=L
            ENCODE(6,970.LIST(L.I)) TFAIL(J.I).IFCOD(J)
    480     CONTINUE
            WRITE(6,905)(TOTT(IT).TOTS(IT).TPCNTT(IT).
          1                  TLNC(IT).TLSU(IT).TPCNTL(IT).IT=1.4)
            WRITE(6,990) ((LIST(I1.I2).I1=1.4) .I2=1.4)
            IF(MAXF.LE.4)GOTO 490
            DO 485 IB=5.MAXF.4
            IE=IB + 3
    485     WRITE(6,990) ((LIST(I1.I2).I1=IB.IE) .I2=1.4)
    490     CONTINUE
            KK=1
            DO 495 K=1.4
            SMEAN1(K)= SUM1(K)/RNST(K)
            SMEAN2(K)= SUM2(K)/RNST(K)
            SIGMA1(K)= SQRT(SUMSQ1(K)/RNST(K)  - SMEAN1(K)*SMEAN1(K))
            SIGMA2(K)= SQRT(SUMSQ2(K)/RNST(K) - SMEAN2(K)*SMEAN2(K))
            DIFFMN(KK)= ABS( SMEAN1(K)-RLTMN(K) )
            DIFFMN(KK+1)=ABS( SMEAN2(K)-RLTMN(K) )
            N=RNST(K)
            RMU(KK)= (T95(N-1)*SIGMA1(K))/SQRT(RNST(K))
            RMU(KK+1)= (T95(N-1)*SIGMA2(K))/SQRT(RNST(K))
```

```
          SIGT(KK)=6HNO
          SIGT(KK+1)=6HNO
          IF(DIFFMN(KK).GT.RMU(KK)) SIGT(KK)=6HYES
          IF(DIFFMN(KK+1).GT.RMU(KK+1)) SIGT(KK+1)=6HYES
          KK=KK+2
  495     CONTINUE
          IF(NCUM.GT.0) GOTO 496
          WRITE(6,991) (SMEAN1(K),SMEAN2(K),K=1,4)
          WRITE(6,992) (SIGMA1(K),SIGMA2(K),K=1,4)
          WRITE(6,993) (RLTMN(K),K=1,4)
          WRITE(6,994) (SIGT(K),K=1,8)
  496     CONTINUE
          PRINT 997
          PRINT 998
          PRINT 999
  997     FORMAT(1H1
         1 5X,  'PRE-LAUNCH FAILURE'./
         2    40X,'CODE        FAILURE',/,
         2  41X,  '01   OPEN SQUIB(MOTOR)'  ,/,
         3   41X, '02   OPEN SQUIB(DART TAIL)' ,/,
         4 41X,  '03   SONDE MALFUNCTION' ,/,
         5 5X,    'FLIGHT FAILURES DUE TO ROCKET MOTOR' ,/
         6  41X,'11   OPEN SQUIB' ,/,
         7 41X,'12   NO-FIRE MISFIRE' ,/,
         8 41X,'13   HANGFIRE' ,/,
         9  41X, '14   MOTOR BURNTHROUGH' ,/,
         A  41X ,   '15   NON-PROGRAMMED' ,/,
         B  41X,  '16   BLOWUP' ,/,
         C  5X,    'FAILURES DUE TO DART' ,/,
         D  41X, '21   PREMATURE EXPULSION' ,/,
         E 41X,'22   LATE EXPULSION' ,/,
         F 41X,  '23   NO EXPULSION' ,/,
         G  41X, '24   LOW APOGEE'   )
  998     FORMAT( 5X,      'FAILURES DUE TO SONDE' ,/,
         1 41X, '31   RF FAILURE(SONDE CUTOFF) AT IGNITION' ,/,
         2  41X,'32   RF FAILURE,EXPULSION(SONDE CUTOFF)' ,/,
         3 41X,   '33   RF FAILURE AFTER EXPULSION(SONDE CUTOFF)',/,
         4  41X, '34   RF FAILURE(BATTERY)' ,/,
         5 41X, '35   MODULATION FAILURE' ,/,
         6 41X, '36   BROKEN THERMISTOR' ,/,
         7 41X,   '37   MISSING REFERENCES' ,/,
         8 41X, '38   MISSING TEMPERATURE' ,/,
         9 41X,  '39   THERMISTOR CUP STUCK' ,/,
         A 41X, '40   RANGING FAILURE'   )
  999     FORMAT( 5X, 'FAILURES DUE TO STARUTE' ,/,
         1 41X,  '51   FAST FALL RATE' ,/,
         2 41X, '52   DAMAGED CHUTE' ,/,
         3 41X,  '53   RETARDATION DEVICE BREAKUP' ,/,
         4 5X,  'FAILURES OF SPHERE SYSTEM' ,/,
         5 41X, '61   PREMATURE COLLAPSE' ,/,
```

```
      6 41X.  '62   INCOMPLETE INFLATION' ./.
      7 41X. '63   SPHERE BREAKUP' ./.
      8 5X.   'FAILURES DUE TO GROUND EQUIPMENT' ./.
      9 41X.' 71   GROUND EQUIPMENT SUPPORT' ./.
      9 41X.' 72   EXTERNAL INTERFERENCE'./.
      A 5X.  'OTHER FAILURES' ./.
      B 41X.  '81   NO TIE-ON' ./.
      C 41X. '82   NO CORAWINSONDE'  )
C      PRINT 998.((PCNTF(I.J).I=1.4).J=1.50)
C      PRINT 997.(XSTAT(I).I=1.15)
       CALL PLOT1(XSTAT.YPCNT.STATID.INS)
       CALL PLOT2(PCNTF.NCODE)
       IF(NCUM.NE.0)
      1 CALL PLOT4(SMONTH.CSTPCT.CSYPCT.LMNTH.NMOS)
       CALL RSTR(3)
       GOTO 800
750    WRITE(6.1000) MY
800    CONTINUE
900    FORMAT(2I5.1X.A4.7I5)
905    FORMAT(/5X'TOTAL'6X4(1XI3.2XI3.1XI3 .2XI3.2XI3.1XI3  .2X))
910    FORMAT(4X.I2)
915    FORMAT(I2.4X)
920    FORMAT(1H1.///.55X.'MONTHLY FAILURE SUMMARY'/.61X.A6.'19' I2 .//.
      142X'CODE  QUANTITY MOTOR LOT NO.  DART   DART   SONDE'./.60X.'SN'.
      2 14X 'SN' 2X 'FUZE SN  SN'./)
930    FORMAT(43X I2. 5X I3. 3X A6.1X A6. 1X A6. 2X A6. 1X A6 )
935    FORMAT(56X A6.1X.A6.1X.A6.2X.A6.1X.A6)
940    FORMAT(1H1.53X 'NETWORK MONTHLY STATISTICS'./.62X.A6.'19'.I2)
945    FORMAT(1H1.51X'CUMULATIVE NETWORK STATISTICS'/60XJ4.' TO 'J4)
950    FORMAT(/.16X.4(10(1H.) A6. 11(1H.) 2X ) )
960    FORMAT(16X.4('TEST SUCC O/O LAUN SUCC O/O  ') )
970    FORMAT( I2.1H-.J2.1H.)
980    FORMAT(/2A6.A4. 4 (1X.I3.2X I3.1X I3  .2X I3.2X I3.1X I3  .2X) )
990    FORMAT(2X.'TYPE FAILURE'. 4( 3X.4A6,2X ) )
991    FORMAT(/2X.'         MEAN '. 4(11X.F4.1.10X.F4.1))
992    FORMAT(2X.'         SIGMA '. 4(11X.F4.1.10X.F4.1))
993    FORMAT(2X.'LONG TERM MEAN' 3X .3(12X.F4.1.13X).12X.F4.1)
994    FORMAT( 2X.'SIGNIFICANT CHANGE?'7X.A3.11X.A3.3(12X.A3.11X.A3))
995    FORMAT(A6.'19'.I2)
1000   FORMAT(5X'....MASTER FILE UPDATED  FOR MONTH-YEAR.... 'A4)
C**        NEED WRITE TOTALS AT END
C**        OF 400 LOOP
       END
```

```
      SUBROUTINE PLOT1(XSTAT,YPCNT,STATID,INS)
      COMMON/DBLOK/NDTA(500,12),TOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
     1              IFCOD(50),NSTAT,NROCK,NCODE,PDATE(2),MYI,MYJ,NCUM
      DIMENSION XSTAT(15,4),STATID(3,15),YLAB(3),YPCNT(15,4,2),
     1          ZLAB1(5),ZLAB2(4),ZLAB3(2),XVAL(15),YVAL(15,4,2)
      DIMENSION INS(4)
C**
      XMIN=0.0
      XMAX=7.0
      XLEN=7.0
      DX=1.0
      YMIN=60.
      YMAX=100.
      YLEN=2.
      DY=20.
      NX=0
      NY=0
      YLAB(1)=6HPER CE
      YLAB(2)=6HNT SUC
      YLAB(3)=6HCESS
      ZLAB1(1)=6HMETEOR
      ZLAB1(2)=6HOLOGIC
      ZLAB1(3)=6HAL ROC
      ZLAB1(4)=6HKET NE
      ZLAB1(5)=6HTWORK
      ZLAB2(1)=6HMONTHL
      ZLAB2(2)=6HY STAT
      ZLAB2(3)=6HISTICS
      ZLAB3(1)=PDATE(1)
      ZLAB3(2)=PDATE(2)
      X2=3.42
      X3=3.9
      NCZ2=18
      NCZ3=10
      IF(NCUM.EQ.0) GOTO 30
      X2=3.24
      X3=3.78
      NCZ2=21
      NCZ3=12
      ENCODE(12,900,ZLAB3) MYI,MYJ
  900 FORMAT(J4,' TO ',J4)
      ZLAB2(1)=6HCUMULA
      ZLAB2(2)=6HTIVE S
      ZLAB2(3)=6HTATIST
      ZLAB2(4)=6HICS
   30 CONTINUE
      XLAB=6H
      CALL RSTR(1)
      CALL PLOT(0.,-.2,-3)
      XC=1.0
```

```
      YC=1.0
      CALL PLOT(XC,YC,3)
      DO 60 I=1,15
      CALL PLOT(XC,YC,3)
      DO 50 J=1,4
      YC=YC+2.0
      CALL PLOT(XC,YC,2)
      YC=YC+.25
50    CALL PLOT(XC,YC,3)
      XC=XC+.5
      YC=1.
60    CONTINUE
      CALL SYMBOL(.70,4.86,.14,YLAB,90.,16)
      CALL SYMBOL(2.76,10.35,.14,ZLAB1,0.,29)
       CALL PLOT(6.78,10.19,3)
      CALL MARKER(4)
      CALL SYMBOL(6.81,10.16,.07,10H = STATION,0.,11)
      CALL SYMBOL(X2,10.18,.14,ZLAB2,0.,NCZ2)
      CALL SYMBOL(6.75, 9.96,.07,17HX = ROCKET SYSTEM,0.,17)
      CALL SYMBOL(X3,10.01,.14,ZLAB3,0.,NCZ3)
      CALL PLOT(0.,0.,-3)
      XC=1.0
      YC=9.75
      DO 100 I=1,4
      J=4-I+1
      CALL SYMBOL(XC+3.14,YC+.05,.14,ROCKID(J),0.,6)
      CALL NUMBER(XC-.2,YC-.05,.07,100.,0.,-1)
      CALL PLOT(XC,YC,3)
      CALL PLOT(XC+XLEN,YC,2)
      CALL NUMBER(XC-.2,YC-1.05,.07, 80.,0.,-1)
      CALL PLOT(XC,YC-1.,3)
      CALL PLOT(XC+XLEN,YC-1.,2)
      CALL NUMBER(XC-.2,YC-2.05,.07, 60.,0.,-1)
      CALL PLOT(XC,YC-2.0,3)
      CALL PLOT(XC+XLEN,YC-2.0,2)
100   YC=YC-2.25
      XC=1.5
      YC=.10
      CALL PLOT(0.,0.,-3)
      DO 200 I=1,NSTAT
      CALL SYMBOL(XC,YC,.07,STATID(1,I),90.,15)
200   XC=XC + .5
      XC=1.0
      YC=1.25
      DO 300 K=1,2
      DO 300 J=1,4
      NP=INS(J)
      DO 300 I=1,NP
      YVAL(I,J,K)=(YPCNT(I,J,K)-YMIN)/DY
      IF(YVAL(I,J,K).LT.0) YVAL(I,J,K)=0.
```

```
300    CONTINUE
C**
C      PRINT 999,(((YVAL(I,J,K),K=1,2),J=1,4),I=1,15)
999    FORMAT(2X,8F10.2)
       XC=1.0
       YC=1.00
       DO 400 I=1,4
       NP=INS(I)
       DO 350 J=1,NP
350    XVAL(J)=(XSTAT(J,I)-XMIN)/DX
C      PRINT 998,(XVAL(K),K=1,15)
998    FORMAT(15F8.2)
C**
       CALL PLOT(XC,YC,-3)
       CALL LINE(XVAL,YVAL(1,I,1),NP,-4,1)
       CALL LINE(XVAL,YVAL(1,I,2),NP,-2,1)
       YC=2.25
400    XC=0.
       CALL PLOT(0.0,0.0,-3)
       CALL RSTR(2)
       RETURN
       END
```

```
      SUBROUTINE PLOT2(PCNTF,NC)
      COMMON/DBLOK/NDTA(500,12),IOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
     1              IFCOD(50),NSTAT,NROCK,NCODE,PDATE(2),MYI,MYJ,NCUM
      DIMENSION  PCNTF(4,50),XLAB(2),YLAB(3),ZLAB1(5),ZLAB3(2),
     1           ZLAB2(4),XVAL(50,4),YVAL(50,4),VVAL(2),HVAL(2)
C**
      XMIN=0.
      XMAX=7.0
      XLEN=7.5
      DX=10.0
      YMIN=0.0
      YMAX=40.
      DY=5.0
      YLEN=8.0
      YLAB(1)=6HPER CE
      YLAB(2)=6HNT FAI
      YLAB(3)=6HLURE
      XLAB(1)=6HFAILUR
      XLAB(2)=6HE CODE
      NX=-12
      NY=16
      ZLAB1(1)=6HMETEOR
      ZLAB1(2)=6HOLOGIC
      ZLAB1(3)=6HAL ROC
      ZLAB1(4)=6HKET NE
      ZLAB1(5)=6HTWORK
      ZLAB2(1)=6HMONTHL
      ZLAB2(2)=6HY STAT
      ZLAB2(3)=6HISTICS
      ZLAB3(1)=PDATE(1)
      ZLAB3(2)=PDATE(2)
      X X2=2 92
      NCZ2=18
      NCZ3=10
      IF(NCUM.EQ.0) GOTO 30
      X2=2.74
      NCZ2=21
      NCZ3=12
      ENCODE(12,900,ZLAB3) MYI,MYJ
  900 FORMAT(J4,' TO ',J4)
      ZLAB2(1)=6HCUMULA
      ZLAB2(2)=6HTIVE S
      ZLAB2(3)=6HTATIST
      ZLAB2(4)=6HICS
   30 CONTINUE
      CALL RSTR(1)
      CALL PLOT(0.,0.,-3)
      CALL AXIS(1.0,1.0,XLAB,NX,XLEN,0.,XMIN,DX,-1)
      CALL AXIS(1.0,1.0,YLAB,NY,YLEN,90.,YMIN,DY,-1)
      CALL SYMBOL(2.26,9.75,.14,ZLAB1,0.,29)
```

```
            CALL SYMBOL(X2,9.58,.14,ZLAB2,0.,NCZ2)
            CALL SYMBOL(3.40,9.41,.14,ZLAB3,0.,NCZ3)
            CALL PLOT(7.0,9.75,3)
            CALL MARKER(1)
            CALL SYMBOL(7.14,9.70,.14,6HPWN8B ,0.,6)
            CALL PLOT(7.0,9.58,3)
            CALL MARKER(2)
            CALL SYMBOL(7.14,9.53,.14,6HPWN10A,0.,6)
            CALL PLOT(7.0,9.41,3)
            CALL MARKER(3)
            CALL SYMBOL(7.14,9.37,.14,6HPWN11A,0.,6)
            CALL PLOT(7.0,9.24,3)
            CALL MARKER(4)
            CALL SYMBOL(7.14,9.19,.14,6HPWN12A,0.,6)
            XC=1.0
            YC=9.0
            DO 70 I=1,8
            CALL PLOT(XC,YC,3)
            XC=10.-XC
            CALL PLOT(XC,YC,2)
            YC=YC-1.
   70       CONTINUE
            XC=1.1
            YC=1.0
            DO 80 I=1,75
            CALL PLOT(XC,YC,3)
            CALL PLOT(XC,YC-.1,2)
            XC=XC+.1
   80       CONTINUE
            XC=9.
            YC=1.0
   C        DO 90 I=1,8
            CALL PLOT(XC,YC,3)
            YC=10.-YC
            CALL PLOT(XC,YC,2)
            XC=XC-1.
   90       CONTINUE
            CALL PLOT(1.,1.,-3)
            DO 200 J=1,4
            KK=0
            DO 150 K=1,NC
             IF(PCNTF(J,K).LE.0.) GOTO 150
            KK=KK+1
            YVAL(KK,J)=(PCNTF(J,K)-YMIN)/DY
            FC=IFCOD(K)
            XVAL(KK,J)=(FC-XMIN)/DX
   150      CONTINUE
            IF(KK.LE.0) GOTO 200
            JC=-J
            CALL LINE(XVAL(1,J),YVAL(1,J),KK,JC,1)
```

```
  200 CONTINUE
      DO 350 K=1,NC
      VVAL(1)=0.
      VVAL(2)=0.
      JJ=0
      DO 300 J=1,4
      IF(PCNTF(J,K).LE.VVAL(2)) GOTO 300
      VVAL(2)= PCNTF(J,K)
      JJ=J
  300 CONTINUE
      IF(JJ.LE.0) GOTO 350
      FC=IFCOD(K)
      HVAL(1)=(FC-XMIN)/DX
      HVAL(2)=HVAL(1)
      VVAL(2)=(PCNTF(JJ,K)-YMIN)/DY
      CALL LINE(HVAL,VVAL,2,0,1)
  350 CONTINUE
      CALL PLOT(0.,0.,-3)
      RETURN
      END
```

17 SERNA•MRQC PLOT3

```
      SUBROUTINE PLOT3(XMONTH,STPCNT.SYPCNT.LMNTH.STATID)
      COMMON/DBLOK/NDTA(500,12),IOP,LU,LUO,LUS,STATCD(15).ROCKID(4).
     1             IFCOD(50).NSTAT,NROCK.NCODE,PDATE(2).MYI.MYJ.NCUM
      DIMENSION XMONTH(12.4).STPCNT(12.4).SYPCNT(12.4).LMNTH(12).
     1 STATID(3).YLAB(3).ZLAB1(5).ZLAB2(6.2).XVAL(12.4).YVAL(12.4.2).
     2 MM(4).NDATES(2)
      DATA XMIN/0./.XMAX/6.0/.YMIN/30./.YMAX/100./.DY/10./.
     1 YLEN/7.0/.XLEN/6.5/.DX/2.0/
      DATA YLAB/6HPER CE.6HNT SUC.6HCESS  /.
     1 ZLAB1/6HMETEOR,6HOLOGIC.6HAL ROC.6HKET NE.6HTWORK /.
     2 ZLAB2/6HCUMULA,6HTIVE S.6HTATION.6H SUCCE.6HSS    .6H     .
     3       6HCUMULA,6HTIVE R.6HOCKET .6HSYSTEM.6H SUCCE.6HSS    /
      DATA NY/16/.NZ1/29/
      IF(NCUM.LE.0) RETURN
      NZ2=26
      XZ2=2.44
      ENCODE(12,900,NDATES) MYI,MYJ
900   FORMAT(J4,' TO ',J4)
      DO 100 K=1,4
      MM(K)=0
      DO 100 M=1.12
      IF(XMONTH(M.K).LE.0.) GOTO 100
      MM(K)=MM(K)+ 1
      KM=MM(K)
      YVAL(KM.K.1)=(STPCNT(M.K)-YMIN)/DY
      YVAL(KM.K.2)=(SYPCNT(M.K)-YMIN)/DY
      IF(YVAL(KM.K.1).LT.0.) YVAL(KM.K.1)=0.
      IF(YVAL(KM.K.2).LT.0.) YVAL(KM.K.2)=0.
       XVAL(KM.K)=(XMONTH(M.K)-XMIN)/DX
100   CONTINUE
      DO 500 J500=1,2
      CALL PLOT (0.,0.,-3)
      XC=1.
      YC=1.
      CALL PLOT(XC.YC.3)
      DO 140 I=1.12
      XC=XC+.5
      CALL PLOT(XC.YC,2)
      CALL PLOT(XC.YC-.1.1)
      CALL PLOT(XC.YC.1)
140   CONTINUE
      XC=1.0
      CALL PLOT(0..0..3)
      CALL AXIS(1.0.1.0. YLAB.NY.YLEN.90..YMIN.DY.-1)
      CALL SYMBOL(2.26,8.92..14.ZLAB1.0..29)
      CALL SYMBOL(XZ2.8.68..14.ZLAB2(1.J500).0..NZ2)
      NZ2=NZ2 + 6
      XZ2=XZ2 - .36
      CALL SYMBOL(3.28.8.44..14.NDATES.0..12)
      CALL SYMBOL(3.10.8.2..14.STATID.0..15)
```

```
      CALL PLOT(6.57,8.75,3)
      CALL MARKER(1)
      CALL SYMBOL(6.64,8.7,.10,6HPWN8B ,0.,6)
      CALL PLOT(6.5,8.58,3)
      CALL MARKER(2)
      CALL SYMBOL(6.64,8.53,.10,6HPWN10A,0.,6)
      CALL PLOT(6.5,8.41,3)
      CALL MARKER(3)
      CALL SYMBOL(6.64,8.37,.10,6HPWN11A,0.,6)
      CALL PLOT(6.5,8.24,3)
      CALL MARKER(4)
      CALL SYMBOL(6.64,8.19,.10,6HPWN12A,0.,6)
      XC=1.0
      YC=1.0
      CALL PLOT(XC,YC,3)
      DO 250 J=1,12
      XC=XC+.5
      CALL SYMBOL(XC-.18,YC-.3,.14,LMNTH(J),0.,3)
250   CONTINUE
      CALL PLOT(1.0,1.0,-3)
      DO 350 J=1,4
      IF(MM(J).LE.0) GO TO 350
      JC=-J
      CALL LINE(XVAL(1,J),YVAL(1,J,JS00),MM(J),JC,1)
350   CONTINUE
      CALL PLOT(0.,0.,-3)
      CALL RSTR(2)
500   CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PLOT4(XMONTH,CSTPCT,CSYPCT,LMNTH,NMOS)
      COMMON/DBLOK/NDTA(500,12),TOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
     1              IFCOD(50),NSTAT,NROCK,NCODE,PDATE(2),MYI,MYJ,NCUM
      DIMENSION XMONTH(12,4),YLAB(3),
     1          ZLAB1(5),ZLAB2(4),ZLAB3(2),XVAL(12,4),YVAL(12,4,2)
      DIMENSION CSTPCT(12,4),CSYPCT(12,4),LMNTH(12),MM(4)
C**
      XMIN=0.0
      XMAX=7.0
      XLEN=6.0
      DX=2.0
      YMIN=60.
      YMAX=100.
      YLEN=2.
      DY=20.
      NX=0
      DO 100 K=1,4
      MM(K)=0
      DO 100 M=1,12
      IF(XMONTH(M,K).LE.0.) GOTO 100
      MM(K)=MM(K)+ 1
      KM=MM(K)
      YVAL(KM,K,1)=(CSTPCT(M,K)-YMIN)/DY
      YVAL(KM,K,2)=(CSYPCT(M,K)-YMIN)/DY
       XVAL(KM,K)=(XMONTH(M,K)-XMIN)/DX
      IF(YVAL(KM,K,1).LE.0.) YVAL(KM,K,1)=0.
      IF(YVAL(KM,K,2).LE.0.) YVAL(KM,K,2)=0.
100   CONTINUE
      NY=0
      YLAB(1)=6HPER CE
      YLAB(2)=6HNT SUC
      YLAB(3)=6HCESS
      ZLAB1(1)=6HMETEOR
      ZLAB1(2)=6HOLOGIC
      ZLAB1(3)=6HAL ROC
      ZLAB1(4)=6HKET NE
      ZLAB1(5)=6HTWORK
      NCZ2=21
      NCZ3=12
      ENCODE(12,900,ZLAB3) MYI,MYJ
900   FORMAT(J4,' TO ',J4)
      ZLAB2(1)=6HCUMULA
      ZLAB2(2)=6HTIVE S
      ZLAB2(3)=6HTATIST
      ZLAB2(4)=6HICS
30    CONTINUE
      XLAB=6H
      CALL RSTR(1)
      CALL PLOT(0.,-.2,-3)
      XC=1.0
```

```
          YC=.75
          DO 60 I=1,13
          CALL PLOT(XC,YC,3)
          DO 50 J=1,4
          YC=YC+2.0
          CALL PLOT(XC,YC,2)
          YC=YC+.25
    50    CALL PLOT(XC,YC,3)
          XC=XC+.5
          YC=.75
    60    CONTINUE
          CALL SYMBOL(.70,4.86,.14,YLAB,90.,16)
          CALL SYMBOL(2.26,10.35,.14,7LAB1,0.,29)
           CALL PLOT(5.78,10.03,3)
          CALL MARKER(4)
          CALL SYMBOL(5.81,10.00,.07,10H = STATION,0.,11)
          CALL SYMBOL(2.74,10.18,.14,7LAB2,0.,NCZ2)
          CALL SYMBOL(5.75,9.83,.07,17HX = ROCKET SYSTEM,0.,17)
          CALL SYMBOL(3.28,10.01,.14,7LAB3,0.,NCZ3)
          CALL PLOT(0.,0.,-3)
          XC=1.0
          YC=9.50
          DO 150 I=1,4
          J=4-I+1
          CALL SYMBOL(XC+2.64,YC+.05,.14,ROCKID(J),0.,6)
          CALL NUMBER(XC-.2,YC-.05,.07,100.,0.,-1)
          CALL PLOT(XC,YC,3)
          CALL PLOT(XC+XLEN,YC,2)
          CALL NUMBER(XC-.2,YC-1.05,.07, 80.,0.,-1)
          CALL PLOT(XC,YC-1.,3)
          CALL PLOT(XC+XLEN,YC-1.,2)
          CALL NUMBER(XC-.2,YC-2.05,.07, 60.,0.,-1)
          CALL PLOT(XC,YC-2.0,3)
          CALL PLOT(XC+XLEN,YC-2.0,2)
    150   YC=YC-2.25
          XC=1.5
          YC=.75
          CALL PLOT(0.,0.,-3)
          DO 200 I=1,12
          CALL PLOT(XC,YC,3)
          CALL PLOT(XC,YC-.1,2)
          CALL SYMBOL(XC-.18,YC-.3,.14,LMNTH(I),0.,3)
    200   XC=XC + .5
    C••
          XC=1.0
          YC=.75
          DO 400 I=1,4
          IF(MM(I).LE.0) GOTO 350
    C••
          CALL PLOT(XC,YC,-3)
```

```
            CALL LINE(XVAL(1,I),YVAL(1,I,1),MM(I), 4,1)
            CALL LINE(XVAL(1,I),YVAL(1,I,2),MM(I), 2,1)
      350   YC=2.25
      400   XC=0.
            CALL PLOT(0.0,0.0,-3)
            CALL RSTR(2)
            RETURN
            END
```

```
      SUBROUTINE READC(IMNTH,NENTRY)
C••
C••      ROUTINE READC IS ROUTINE TO READ CARD INPUT
C••      ENTRIES ARE SORTED BY STATION CODE.THEN BY ROCKET TYPE
C••      AND LAST BY PRIMARY FAILURE CODE
C••
      INTEGER STATCD,STATN,ROCKID,RTYPE
      COMMON/DBLOK/NDTA(500,12),IOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
     1              IFCOD(50),NSTAT, NROCK,NCODE,PDATE(2),MYI,MYJ,NCUM
      DIMENSION STATN(500),RTYPE(500)
      EQUIVALENCE (NDTA(1,1),STATN(1)), (NDTA(1,4),RTYPE(1))
C••
      I=1
100   READ(5,900,END=120) (NDTA(I,J),J=1,12)
C••
      WRITE(6,910) (NDTA(I,J),J=1,12)
      I=I+1
      GOTO 100
120   NENTRY=I-1
      CALL SORT(NDTA,1,1,NENTRY,12)
      ISN=1
      DO 200 I=1,NSTAT
      CALL SEARCH(STATN(ISN),NENTRY,STATCD(I),N,M)
      N=N+ISN-1
      IF(M.LE.1) GOTO 200
      ISN= ISN + M
      CALL SORT(NDTA(1,2),N,3,M,11)
C••      N IS POINTER TO NDTA ARRAY LOCATION WHERE STATCD(I)
C••      INFO BEGINS
C••      M IS NUMBER OF ENTRIES FOR STATCD(I)
C••
      ISR=N
      DO 150 J=1,4
      CALL SEARCH(RTYPE(ISR),M,ROCKID(J),NN,MM)
      NN=NN+ISR-1
      IF(MM.LE.1) GOTO 150
C••      NN IS POINTER TO NDTA ARRAY WHERE ROCKID(J) INFO STARTS
C••      MM IS NUMBER OF ENTRIES FOR ROCKID(J)
C••
      CALL SORT(NDTA(1,2),NN,10,MM,11)
150   CONTINUE
200   CONTINUE
      DO 300 I=1,NENTRY
      WRITE(LUS)(NDTA(I,J),J=1,12)
300   CONTINUE
      ENDFILE LUS
      REWIND LUS
      DECODE(6,920,NDTA(1,2)) IMNTH
      RETURN
900   FORMAT(I5,1X,9A6,2I6)
```

```
910   FORMAT(2X,I5,1X,9A6,2J2)
920   FORMAT(I2,4X)
      END
```

21   SERNA•MRQC   READF

```
      SUBROUTINE READF(IDATE,NENTRY,NCUM,KFLAG)
      COMMON/DBLOK/NDTA(500,12),TOP,LU,LUO,LUS,STATCD(15),ROCKID(4),
     1           IFCOD(50),NSTAT,NROCK,NCODE
      COMMON/DIR/IRSTAT,NUMREC,NUMON,NDATE(60),NFR(60),NLR(60)
C
C        THIS ROUTINE WILL READ DATE FOR MONTH-YEAR IDATE AND STORE
C        THE DATA IN ARRAY NDTA AS WELL AS ON SCRATH FILE LUS
C        IRSTAT=1 IF MASTER FILE DIRECTORY HAS BEEN READ AND THEREFORE
C        INFO IS IN CORE
C
C**      IDATE IS INTEGER...NEED DATE IN ALPHA BECAUSE NDATE IS ALPHA
      IF(IRSTAT.EQ.1)GOTO 100
      CALL SETADR(LU,0)
      IRSTAT=1
      READ(LU) NCON,(NDATE(J),NFR(J),NLR(J),J=1,8)
      NUMREC=FLD(0,18,NCON)
      NUMON=FLD(18,18,NCON)
      IF(NUMON.LT.9)GOTO 100
      JF=9
      JL=16
      DO 50 I=1,6
      READ(LU) (NDATE(J),NFR(J),NLR(J),J=JF,JL),DUM
      JF=JF+8
      JL=JL+8
50    CONTINUE
100   KFLAG=0
C
C        KFLAG IS SET TO 1 WHEN THE REQUESTED MONTH-YEAR
C     IS NOT FOUND IN THE MASTER FILE
C
      ENCODE(6,900,KDATE)IDATE
900   FORMAT(J4,2H  )
      DO 200 J=1,NUMON
      IF(NDATE(J).NE.KDATE)GOTO 200
      JSAVE=J
      GOTO 250
200   CONTINUE
      KFLAG=1
      RETURN
250   CONTINUE
      IFR=NFR(JSAVE)
      ILR=NLR(JSAVE)
      CALL SETADR(LU,IFR)
      JF=1
      JL=2
      DO 300 I=IFR,ILR
      READ(LU)((NDTA(J,K),K=1,12),J=JF,JL)
      JF=JF+2
      JL=JL+2
300   CONTINUE
```

```
      JL=JL-2
      NENTRY=JL
      IF(NDTA(JL,1).EQ.0) NENTRY=NENTRY-1
      IF(NCUM.NE.0) RETURN
      DO 400 I=1,NENTRY
      WRITE(LUS) (NDTA(I,J),J=1,12)
  400 CONTINUE
      ENDFILE LUS
      REWIND LUS
      RETURN
      END
```

22   SERNA•MRQC SEARCH

```
      SUBROUTINE SEARCH(A,N, SITFM, NPNT, M)
C**       SEARCH IS ROUTINE TO SFARCH ARRAY A FROM A(1) THRU A(N)
C**       FOR SEARCH ITEM SITEM AND STORE POINTER (NPNT) TO FIRST
C**       LOCATION IN A WHER SITFM APPEARS.
C**       M IS THE TOTAL NUMBER OF SFQUENTIAL LOCATIONS CONTAINING
C**       SITEM. SEARCH ITEMS IN A MUST BF STORED SEQUENTIALLY
C**
      INTFGER A, SITEM
      DIMFNSION A(1)
      NPNT=0
      M=0
      DO 100 J=1,N
      IF(A(J).NE.SITEM)GOTO 100
      NPNT=J
      M=M+1
      GOTO 150
  100 CONTINUE
      GOTO 300
  150 CONTINUE
      NS=NPNT+1
      IF(NS.GT.N) GOTO 300
      DO 200 J=NS,N
      IF(A(J).NE.SITEM) GOTO 200
      M=M+1
  200 CONTINUE
  300 RETURN
      END
```

```
23      SERNA*MRQC  SORT

          SUBROUTINE SORT( A,L, KEY, N, M )
          INTEGER A,T
C**           SUBROUTINE SORT  SORTS BLOCK A(1) THRU A(N)
C**           AND PUTS IN ASCENDING ORDER BY KEY CELL
C**           M IS THE NUMBER OF CELLS PER BLOCK
C**           KEY IS THE CELL NUMBER ON WHICH THE SORT IS KEYED
C**
          DIMENSION A(500,1)
C**
          IF(N.LE.1) GOTO 200
          N1=(L+N-1)-1
          JN=L+N-1
          KM=M
          IL=L
          DO 100 I=IL,N1
          J1= I+1
          DO 100 J=J1,JN
          IF(A(I,KEY).LE.A(J,KEY)) GOTO 100
          DO 50 K=1,KM
          T=A(I,K)
          A(I,K)= A(J,K)
50        A(J,K)= T
100       CONTINUE
200       RETURN
          END
```

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